Planning of High Speed Rail Station Area Development:
A case study of Surat and Anand/Nadiad

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In partial fulfillment of the requirements for the award of the degree

Master of Technology
In
Urban Planning

by

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I, **Karan Thakkar,** hereby declare that this project titled **"Planning of High Speed Rail Station Area Development: A case study of Surat and Anand/Nadiad"** is carried out by me in the **Department of Architecture and Planning** of Visvesvaraya National Institute of Technology, Nagpur. The work is original and has not been submitted earlier whole or in part for the award of any degree/diploma at this or any other Institution / University.

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Acknowledgment

"कायेन वाचा मनसेंद्रियैर्वा बुद्ध्यात्मना वा प्रकृतेः स्वभावात्।
करोमि यद्यत्सकलं परस्मै नारायणायेति समर्पयामि॥"

Whatever I do—by body, speech, mind, or nature—I offer it all to Lord Narayan.

With heartfelt devotion, I dedicate this thesis to **Lord Narayan**, the eternal source of strength and purpose in my journey.

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"આ મુસાફરીમાં જેને પણ સાથ મળ્યો, માર્ગદર્શન મળ્યું - તમામ પ્રત્યે હું હૃદયથી આભારી છું."
(To all who walked with me, guided me, or blessed me on this journey – I am deeply grateful from the heart.)

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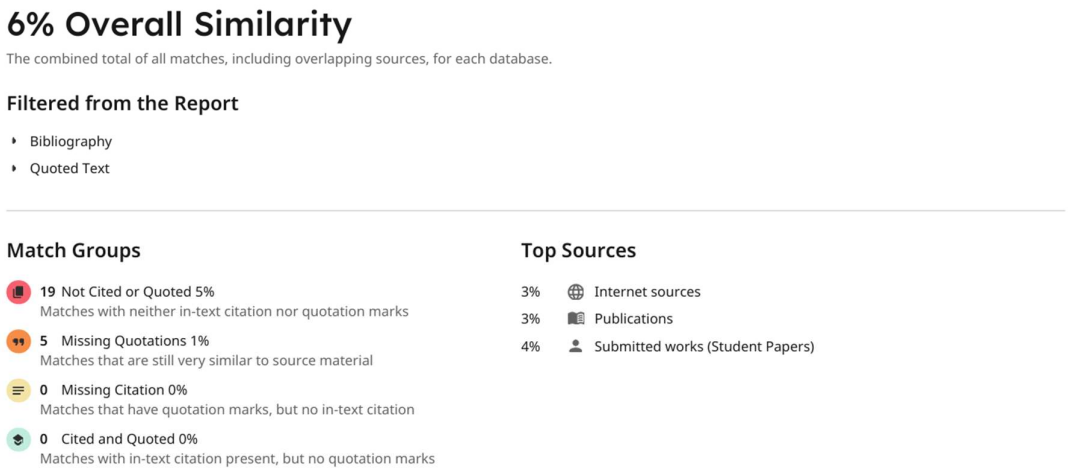
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ABSTRACT

This study examined the transformative role of High-Speed Rail (HSR) in shaping India's urban development, focusing on the Mumbai–Ahmedabad corridor. Through a comprehensive literature review and analysis of international best practices, the research explored HSR's implications at regional, urban, and local scales. The integration of Transit-Oriented Development (TOD) principles was emphasized to promote compact, mixed-use, and high-density development near HSR stations, highlighting the need for coordinated land use and transport planning to support sustainable and inclusive growth.

Building on this foundation, the research advances a strategic framework for Station Area Development Plans around the Greenfield HSR stations at Surat and Anand/Nadiad. The study applies the TOD 3V Framework—Node, Place, and Market—to assess spatial accessibility, urban form, and market dynamics within carefully delineated station influence zones. Planning boundaries were defined using TOD principles, guiding a focused approach to land use and infrastructure planning.

The methodology employs a combination of GIS-based weighted overlay analysis and Location Quotient (LQ) profiling to evaluate land suitability and identify sectoral economic strengths. These analyses informed the prioritization of land uses and development activities aligned with local needs and broader economic opportunities. Expert consultations were integral in refining the functional zoning, which includes TOD Core, Trade, Residential, Institutional, Green, and Civic zones, each designed to maximize connectivity, market potential, and infrastructure capacity.

The results highlight different development paths for the two stations. Surat is well-positioned for rapid and extensive growth due to its strong integration with the existing urban fabric and a high level of market readiness. In contrast, Anand/Nadiad shows significant potential for long-term growth, achievable through carefully planned, phased interventions. The study concludes with a phased implementation framework that prioritizes enhanced multimodal connectivity, targeted infrastructure investments, and effective zoning regulations. This framework affirms the critical role of High-Speed Rail in promoting inclusive and sustainable urban development in India.

Keywords- High-Speed Rail (HSR), Transit-Oriented Development (TOD), 3V Framework-Node-Place-Market Framework, Station Area Development Plan, Land Suitability

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Chapter -1
INTRODUCTION

This chapter introduces High-Speed Rail (HSR), defining its key features and its impact on urban development. It outlines the benefits and challenges of HSR, emphasizing its importance for India's economic growth and sustainable urbanization. The need for strategic planning of HSR Station Influence Areas (HSR-SIA) is highlighted to maximize development opportunities. Finally, the chapter presents the research aim, objectives, scope, and methodology

1.1 High Speed Rail Background

High-Speed Rail (HSR) is a mass transit system that facilitates rapid, convenient, and comfortable travel between major cities. Unlike conventional railways, HSR is a higher-order transit mode requiring advanced infrastructure and significant travel demand for effective operation. As a ground-based transport infrastructure, HSR significantly influences surrounding land use. Due to its high operational and maintenance costs, HSR typically functions on high-demand mobility corridors, presenting numerous urban development opportunities.

Strategic urban planning can harness these opportunities. A Station Area (SA) plan should support high densities of residents, employment, commercial activities, and recreational facilities. It should seamlessly connect with the existing urban fabric through efficient links to railways, airports, and other public transit systems, promoting sustainable development.

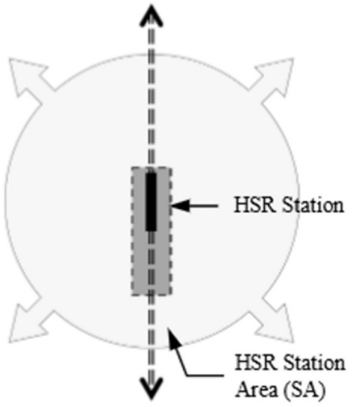


Figure 1 HSR Station Influence Area

The National High-Speed Rail Corporation (NHSRCL) is tasked with designing, constructing, and maintaining HSR station buildings and areas. Their study highlights the importance of capturing development opportunities and addressing challenges in Station Areas (SA) for the success of HSR. This research project aims to assist planning authorities and NHSRCL in formulating effective planning strategies for High-Speed Rail Station Influence Areas (HSR-SA).

1.2 Advantages and Disadvantages of HSR Development

High-speed rail (HSR) development brings a range of **advantages** and **disadvantages** that significantly impact **urban planning** and **regional connectivity**. One of the primary benefits is the substantial **reduction in travel times**. For example, the **Mumbai-Ahmedabad corridor** is designed to shorten travel time to just over two hours, making it a highly attractive option for commuters. Additionally, HSR stimulates **economic growth** by attracting businesses and investments in areas surrounding its stations, which often leads to increased **property values** and **job creation** .Environmentally, HSR is a more **sustainable transportation choice** compared to road and air travel, as it has a lower **carbon footprint per passenger** and promotes urban development that reduces reliance on cars . Furthermore, HSR enhances **connectivity** by integrating seamlessly with existing transportation networks, creating a comprehensive transit system that improves regional accessibility. (Gyanesh, 2024)

Despite these advantages, HSR implementation faces several **challenges**. The high initial costs associated with constructing HSR infrastructure can strain public budgets and divert funds from other essential services. Land acquisition for HSR projects can lead to disputes with landowners and require lengthy negotiations, particularly in densely populated areas. Operational and maintenance costs can also be substantial, necessitating careful financial planning. Additionally, the construction of HSR lines may displace communities or disrupt existing neighborhoods, leading to social challenges and opposition from affected residents.

In summary, while HSR offers significant benefits, its challenges must be thoughtfully addressed in urban planning efforts. (Derek Markham, 24)

1.3 Necessity of HSR in India

High-speed rail (HSR) is a transformative solution for India's transportation and urban development needs. It significantly reduces travel time between major cities—such as the Mumbai-Ahmedabad corridor, which aims to cut the journey to just over two hours—making it a competitive alternative to conventional rail and air travel. This improved connectivity boosts regional accessibility, stimulates business investment, and promotes economic growth around HSR stations.

HSR also aligns with India’s environmental goals by offering a low-emission, energy-efficient mode of transport, encouraging public transit use over private vehicles. Integrating HSR with existing networks creates a seamless transit system, enhancing access to jobs and services.

Moreover, HSR stations can drive urban regeneration by enabling transit-oriented development and revitalizing underutilized areas through mixed-use planning. Although challenges such as high costs, land acquisition, and technology transfer remain, the long-term benefits of HSR in terms of mobility, sustainability, and economic impact make it a vital infrastructure investment for India's future. (Roy & Maji, 2019) (Gupta, 2024)

1.4 Need of the topic

The advancement of High-Speed Rail (HSR) in India extends beyond the mere construction of new rail lines; it fundamentally requires a strategic approach to the development of the areas surrounding these stations to fully harness their potential advantages. Careful planning of High-Speed Rail Station Influence Areas (HSR SIA) is vital to ensure that urban growth is in harmony with the transformative power of HSR. The importance of this initiative is highlighted by the achievements seen in nations like Japan, China, and France, which have successfully utilized HSR to stimulate urban development. For example, the Shin Yokohama HSR Station Area in Japan has transformed into a hub for commercial, hospitality, and cultural activities. Likewise, cities such as Hangzhou in China have undergone significant urban revitalization associated with the introduction of HSR, improving connectivity and economic dynamism.

In India, the National Transit Oriented Development (N-TOD) policy underscores the significance of planning around transit nodes; however, the distinct nature of HSR demands tailored planning strategies that account for the scale of development necessary to support high-speed rail. This involves integrating land use planning with transportation infrastructure while addressing the needs and aspirations of the community to promote inclusive growth.

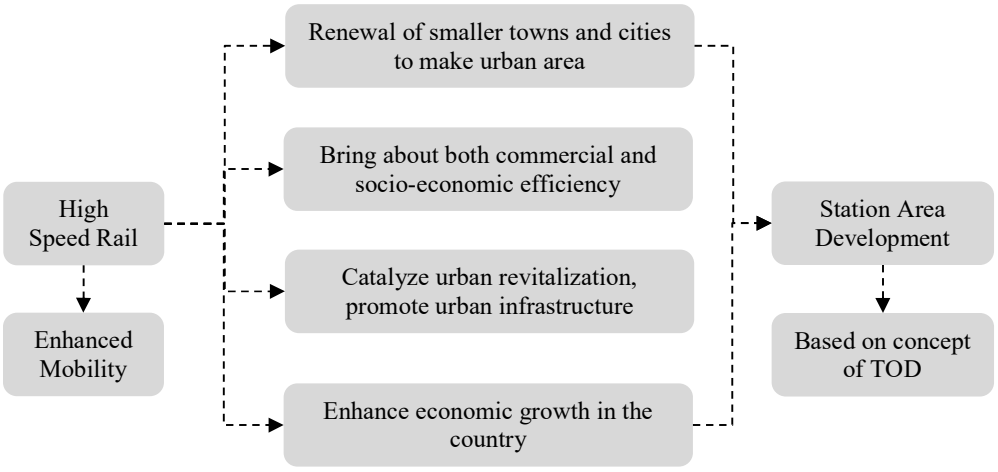

Renewal of smaller towns and cities to make urban area
Bring about both commercial and socio-economic efficiency
High Speed Rail
Station Area Development
Catalyze urban revitalization, promote urban infrastructure
Enhanced Mobility
Based on concept of TOD
Enhance economic growth in the country

Figure 2 Potential of HSR in the Realm of Urban Development

Effective planning of HSR Station Influence Areas is essential for maximizing the advantages of this transformative transportation mode. By focusing on land use, infrastructure requirements, economic prospects, and community involvement through detailed planning, cities can foster vibrant, sustainable, and resilient urban environments that benefit from the presence of HSR. This holistic approach will ensure that India fully leverages the potential of High-Speed Rail to transform its urban landscape while tackling contemporary issues such as congestion, pollution, and uneven regional development (ADB, 2022)

Figure 4 Shin-Yokohama Station as of 1993

Figure 3 Shin-Yokohama Station as of 2024

1.5 Aim

To prepare a Station Area Development Plan based on TOD principles for the Anand/Nadiad and Surat HSR stations.

1.6 Objectives

Phase -1

I. **To understand** HSROD, its **theories**, **principles**, and **relevance** to urban planning.

II. **To identify** key indicators and variables for HSROD and understand their **methods of analysis**.

Phase 2

I. To **delineate** the **study area** around the **HSR station** location by applying **TOD principles** to guide the **planning boundaries**.

II. To conduct **data collection** and **analysis** to assess the area's potential, focusing on **land use**, **infrastructure**, and **accessibility**.

III. To assess the station area using the **TOD-based 3V Framework** to evaluate **spatial accessibility**, **land readiness**, and **market potential**.

IV. To finalize **station area development** activities and **land use distribution** through **expert consultation**, supported by **spatial** and **economic analysis**.

V. To provide **planning proposals, interventions, and policy recommendations** for an HSR TOD-based **Station Area Development Plan** within the influence zones of HSR stations.

1.7 Scope / Limitation

The study focuses on planning **High-Speed Rail Oriented Development (HSROD)** around the **Surat** and **Anand/Nadiad HSR stations**, both situated in **Greenfield contexts** along the **Mumbai–Ahmedabad High-Speed Rail (MAHSR) corridor**. A **1.5 km station influence zone** has been defined for each site to develop a **Station Area Development Plan (SADP)**. The planning approach is based on the **3V Framework**

derived from Transit-Oriented Development (TOD) principles, addressing **land use structuring**, **zoning regulations**, and **multimodal connectivity**. The proposals are supported by **secondary data analysis**, **land suitability studies**, and **expert consultations**.

The study is limited to preparing the **Station Area Development Plan (SADP)** and does not extend to **regional integration**, **transport demand modeling**, or **institutional and governance frameworks.** Due to the academic nature of this study, **direct consultation with landowners or plot-level stakeholders** was not conducted, which restricts the incorporation of **individual stakeholder feedback**. The scope of **primary data collection** was limited, and detailed **feasibility assessments** or **cost analyses** were not included, as these require extensive institutional support and practical execution resources.

1.8 Methodology

The **methodology** begins with defining the **study background**, **aim**, **objectives**, **scope**, and **limitations**, supported by a thorough **literature review** on **HSROD**, **TOD**, and global best practices. The research focuses on identifying key **indicators** using the **TOD 3V Framework** (Node, Place, and Market) and studying relevant **case studies** like Japan TOD and Surat EMP.

Next, **stakeholder consultations** and **expert surveys** help finalize **LAP activities** and **land use allocations**. **Secondary data** on land use, infrastructure, and economic factors is collected, and the **study area** is delineated based on **accessibility**, **development potential**, and **urban form**. **Spatial analyses** such as **KDE**, **Location Quotient (LQ)**, and **Service-Job Gap** assessments are applied within the **TOD framework** to determine activity patterns.

Finally, **land suitability** is assessed via **weighted overlay GIS analysis**. These results are combined with activity zones to create **zoning maps** and street hierarchies following **TOD principles**. The methodology concludes with **planning recommendations** for **zoning regulations**, **infrastructure improvements**, **transport integration**, and **phased development strategies** to guide growth around the HSR stations.

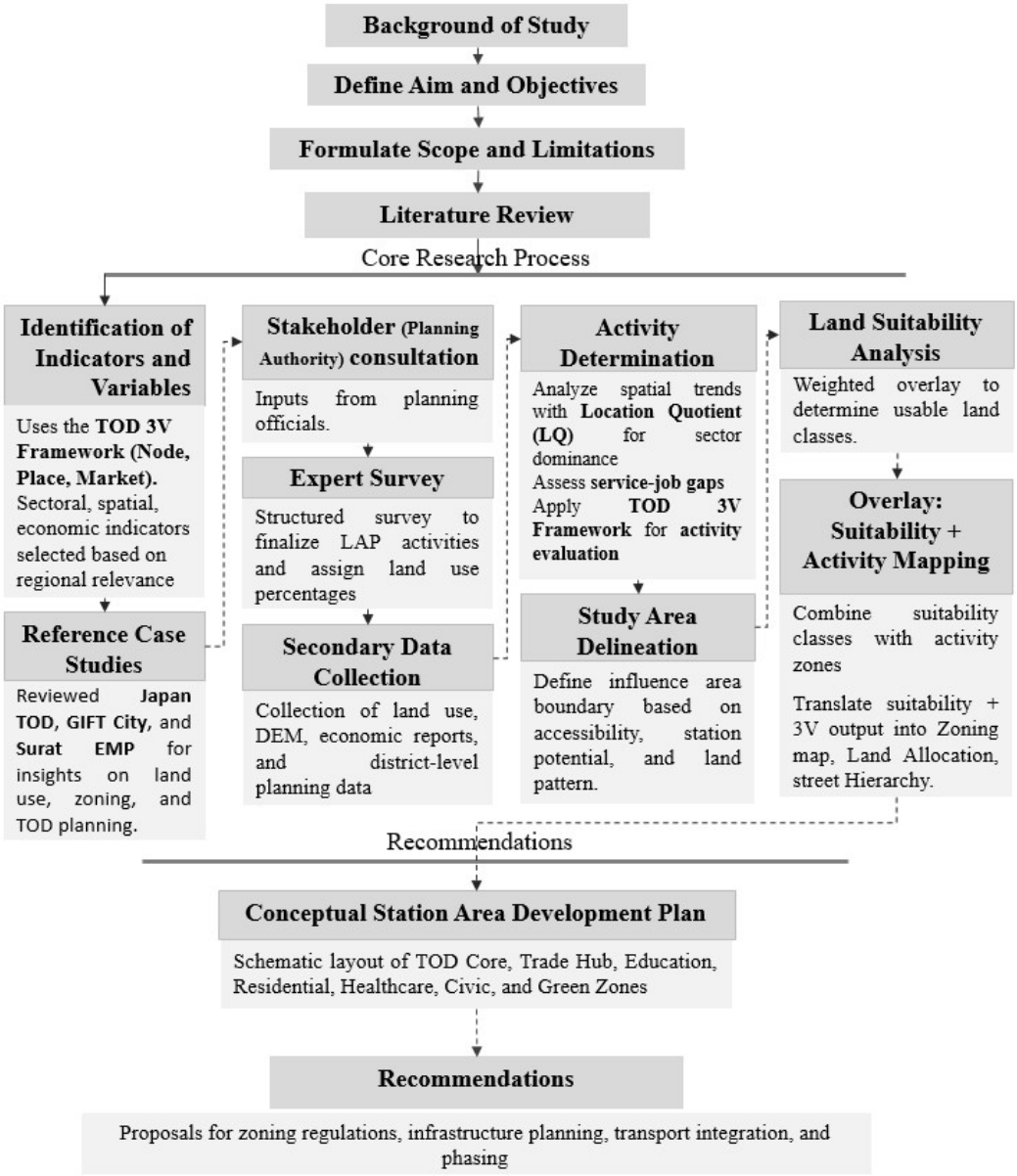

Background of Study
Define Aim and Objectives
Formulate Scope and Limitations
Literature Review
Core Research Process
Identification of Indicators and Variables
Uses the TOD 3V Framework (Node, Place, Market). Sectoral, spatial, economic indicators selected based on regional relevance
Reference Case Studies
Reviewed Japan TOD, GIFT City, and Surat EMP for insights on land use, zoning, and TOD planning.
Stakeholder (Planning Authority) consultation
Inputs from planning officials.
Expert Survey
Structured survey to finalize LAP activities and assign land use percentages
Secondary Data Collection
Collection of land use, DEM, economic reports, and district-level planning data
Activity Determination
Analyze spatial trends with Location Quotient (LQ) for sector dominance
Assess service-job gaps
Apply TOD 3V Framework for activity evaluation
Study Area Delineation
Define influence area boundary based on accessibility, station potential, and land pattern.
Land Suitability Analysis
Weighted overlay to determine usable land classes.
Overlay: Suitability + Activity Mapping
Combine suitability classes with activity zones
Translate suitability + 3V output into Zoning map, Land Allocation, street Hierarchy.
Recommendations
Conceptual Station Area Development Plan
Schematic layout of TOD Core, Trade Hub, Education, Residential, Healthcare, Civic, and Green Zones
Recommendations
Proposals for zoning regulations, infrastructure planning, transport integration, and phasing

Figure 5 Methodology Project Phase-II

Summary: This chapter establishes the importance of HSR and its urban planning implications in India. It justifies the study by emphasizing the need for effective planning around HSR stations to harness their full potential, setting the stage for detailed analysis and proposed interventions.

Chapter - 2

LITERATURE STUDY

This chapter reviews key literature on High-Speed Rail (HSR) and its impacts on urban development across multiple scales. It defines essential terms related to HSR and Transit-Oriented Development (TOD), traces the global evolution of HSR, and examines its influence at regional, urban, and local levels through planning models and theories. The chapter concludes with international TOD case studies—especially from Japan—and a national case study of GIFT City, extracting lessons for effective HSR station area planning.

2.1 Terminology

Transport Corridor

A linear geographic area defined by major transportation routes, such as railways and highways that connect key cities or regions. Transport corridors often serve as focal points for economic and infrastructure development, facilitating trade and mobility. (Shreyas Bharule, 2019)

High-Speed Rail (HSR)

A rail transport system designed to operate at speeds exceeding 250 km/h (155 mph) on dedicated tracks, or above 200 km/h (125 mph) on upgraded conventional lines. HSR provides a fast and efficient alternative for long-distance travel, significantly reducing travel times between urban centers. (Yue Lu, 2022)

High-Speed Rail Station Area (HSR SA)

The geographic region surrounding an HSR station that experiences urban growth and economic development as a result of improved accessibility. HSR SAs often attract businesses, residential developments, and public amenities, enhancing local economies and livability. (Hayashi, 2021)

Station Influence Area (SIA)

The area surrounding a transportation hub, such as an HSR station, where there is notable change in land use, development patterns, and economic activity due to the station's presence. SIAs typically see increases in property values, new commercial projects, and improved infrastructure. (Shaohui Zou, 2024)

Transit-Oriented Development (TOD)

An urban planning strategy that promotes the creation of dense, walkable communities centered on public transit hubs. TOD aims to reduce car dependency, increase public transit usage, and foster sustainable living by integrating residential, commercial, and recreational spaces. (Shreyas Bharule, 2019)

High-Speed Rail Oriented Development (HSROD)

A specific form of Transit-Oriented Development (TOD) focused on optimizing the benefits of high-speed rail connectivity. HSROD emphasizes mixed-use development near HSR stations, enhancing access to transit and promoting economic activity. (Hayashi, 2021)

Mixed-Use Development

A development approach that combines residential, commercial, and recreational spaces within the same area or building. This strategy promotes efficiency, reduces travel times, and encourages urban density by creating vibrant neighborhoods where people can live, work, and play. (Shaohui Zou, 2024)

Greenfield Development

The construction of new buildings or infrastructure on previously undeveloped land, often located on the outskirts of urban areas. In the context of HSR planning, Greenfield development refers to the establishment of new stations and associated infrastructure in areas with no prior development. (Yue Lu, 2022)

Brownfield Redevelopment

The process of revitalizing previously used or contaminated land, often found in urban settings. HSR stations can catalyze brownfield redevelopment by attracting investment and enhancing local accessibility, transforming underutilized sites into productive spaces. (Yue Lu, 2022)

Last-Mile Connectivity

Solutions that address the final segment of a journey, linking passengers from transit hubs (like HSR stations) to their ultimate destinations. This can include walking, biking, ride-sharing services, and shuttle buses, making public transit more accessible and convenient. (Shreyas Bharule, 2019)

Multimodal Transportation

A transportation system that integrates various modes of travel—such as buses, trains, bicycles, and walking—into a cohesive network. Multimodal transportation enhances

efficiency and connectivity, facilitating seamless travel for passengers. (Shaohui Zou, 2024)

Accessibility

The design and implementation of public spaces and transport systems to ensure they are usable by all individuals, including those with disabilities. This involves removing physical and sensory barriers to promote equal access and mobility. (Hayashi, 2021)

Urban Regeneration

The revitalization and renewal of declining urban areas, often focused around transportation hubs like HSR stations. Urban regeneration leverages improved connectivity to drive economic growth, social development, and enhanced quality of life.

Zoning

The legal framework that divides land into designated areas for specific uses, such as residential, commercial, and industrial. Zoning helps guide urban development, ensuring that land is utilized in a way that maintains harmony and meets community needs.

Regional Connectivity

The extent to which different areas, particularly cities and regions, are interconnected through transportation networks like high-speed rail. Improved regional connectivity enhances access to jobs, services, and economic opportunities, fostering regional development. (Gyanesh, 2024)

2.2 High Speed Rail across the world

High-speed rail (HSR) has a rich history marked by significant milestones that have shaped its development and expansion across the globe. The journey began in 1830 when George Stephenson's "Rocket" locomotive achieved a speed of 50 km/h, setting the stage for future advancements in rail technology.

Figure 6 Countries with High Speed Rail Network in commercial operation and underway

By 1903, Siemens and AEG had developed the first electric railcar capable of reaching 210 km/h, showcasing the potential of electric traction in enhancing rail speeds.

The true breakthrough for HSR came on October 1, 1964, with the launch of the Shinkansen in Japan, the world's first high-speed rail system. This line connected Tokyo and Osaka over a distance of 515 km and was designed to meet the growing transport demands of Japan's rapidly developing economy. The Shinkansen operated at speeds of 210 km/h, which were later increased, and it marked a pivotal moment in railway history, demonstrating that trains could compete effectively with air travel.

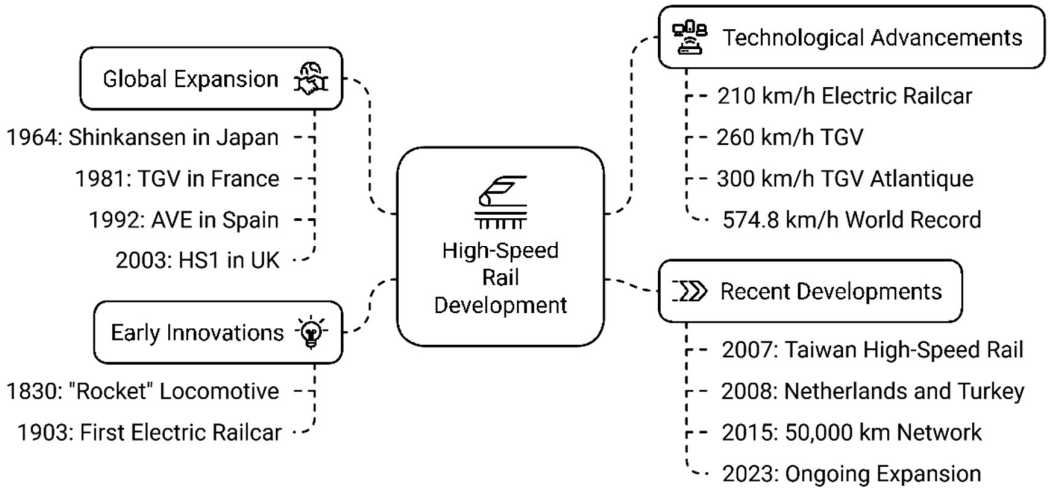


Figure 7 History of High Speed Rail Development

Following Japan's lead, European countries began to develop their own high-speed rail networks. France introduced the TGV (Train à Grande Vitesse) in 1981, operating on the Paris-Lyons line at speeds of 260 km/h. This success inspired further developments across Europe, including Italy's Pendolino and Germany's InterCity-Express (ICE).By the late 20th century and into the early 21st century, countries like China rapidly expanded their HSR networks, with China becoming a global leader in HSR development.

As of now, there are approximately 56,000 km of HSR lines operational worldwide, serving over three billion passengers annually. The evolution of HSR reflects ongoing technological advancements and a commitment to providing efficient transportation solutions that enhance regional connectivity and economic growth. (Hayashi, 2021).

2.3 HSR on Multiscale Development

Table 1 HSR on Multi scale Development Models

Planning Level	Objectives	Key Strategies	Spatial Relationships	Spatial Demand	Models/ Theories	Key Indicators/ Parameters
Regional	Enhance regional connectivity, promote balanced growth, and reduce travel time	Long-term government planning, public-private partnerships, integration with urban development	Spatial accessibility, network connectivity, inter-regional linkages	Identification of accessible resources within specific timeframes	Spatial Interaction Theory, Regional Economic Development Models	Accessibility Index, Economic Growth Rate, Inter-regional Trade
Urban	Attract investment, stimulate economic growth, and create sustainable urban environments	Integrated land use and transport planning, station area development, TOD principles	Station-city center relationships, station-transport network integration, functional relationships between station areas	Assessment of future land use patterns, identification of potential development sites	Urbanization Theory, Transit-Oriented Development (TOD) Theory	Population Density, Employment Density, Land Value Appreciation
Local	Promote mixed-use development, enhance livability, and create vibrant neighborhoods	Zoning regulations, infrastructure investment, community engagement	Land use patterns around stations, pedestrian and cycling infrastructure, public space quality	Assessment of local needs and preferences, identification of development opportunities	Circle-Style Development Theory, New Urbanism	Land Use Mix, Walkability Index, Public Transportation Usage

The integration of High-Speed Rail (HSR) into urban planning is essential for enhancing connectivity and promoting sustainable development. By focusing on regional, urban, and local levels, HSR initiatives can stimulate economic growth, improve accessibility, and create vibrant communities. Effective planning strategies, such as Transit-Oriented Development (TOD) principles and public-private partnerships, are critical for maximizing the benefits of HSR while addressing local needs and fostering inclusive urban environments.

2.4 International Success Stories of Tod - Japan

The **Tokyo Metropolitan Area** serves as a prime example of successful **Transit-Oriented Development (TOD)**, particularly through its integration with the **Shinkansen** high-speed rail network. The evolution of Tokyo's TOD began with the First National Capital Region Development Plan in 1958, which aimed to manage postwar population growth and enhance the city's international competitiveness. This approach aligns land use with transportation planning, effectively supporting urban development around transit hubs.

Table 2 Tokyo's TOD Success

Tokyo's TOD Success	Stakeholder Collaboration	Government , Transit Operators , Developers , Residents
	Comfortable Urban Spaces	Accessibility, Quality of Life
	High-Density Development	Residential Areas, Commercial Spaces, Recreational Spaces
	Multimodal Integration	Shinkansen Connections, Other Transport Modes

Tokyo's TOD strategy emphasizes high-density mixed-use developments that facilitate easy access to public transit, thereby reducing reliance on private vehicles. The integration of various transportation modes, including buses and subways, with the Shinkansen network enhances connectivity throughout the metropolitan area. This comprehensive planning not only improves mobility but also fosters economic vitality by attracting businesses and residents to areas near transit stations.

Table 3 A Multi-Level Approach to TOD in Tokyo

Levels	**Metropolitan Level**	**Corridor Level**	**Station Area Level**	**Site Level**
Policy Objective	Realize the multi-polar and decentralized land use by fixing the concentration of population and urban functions in Tokyo.	Strengthen access between Tokyo and suburban core cities and between suburban core cities by road, rail, and others.	Upgrade urban functions, improve living environment, and develop internationally competitive hubs to deal with a declining birthrate and aging population.	
Policy Plan	The Fourth National Capital Region Development Plan (1986): Develop suburban cities, strengthen cooperation, and promote the relocation of population and urban functions from Tokyo to the suburban areas.		Establish the Advisory Council for the Promotion of Urban Renewal (2000).	

Organization	Establish the National Land Agency (1974)		Establish or expand relevant national departments (as needed).
Framework	Multi-Polar Patterns National Land Formation Promotion Act (1988), Act on Special Measures concerning Comprehensive Advancement of Housing Development and Railway Construction in Metropolitan Areas (1989), and others. Flexible application of Factory Location Law and University Establishment Guidelines, etc.		Amendment of City Planning Act, etc. Act on Special Measures concerning Urban Reconstruction (2002), and others.
Policy Development	Promote the relocation of government research institutes (86 institutions), universities, and others to the Saitama New Urban Center, Makuhari New Urban Center, Minato Mirai 21, Chiba New Town, Tsukuba Science City, Tachikawa, Hachioji, and others.	Railway: Develop Tsukuba Express, Hokuso Line, Keiyo Line, Yokohama Municipal Subway, etc. Promote through service of different lines, etc. Roads: Develop Tokyo Outer Ring Road and Ken-O Expressway.	Designate Chiba, Tokyo, Yurakucho, Akihabara, Kanda, Shinjuku, Shinagawa, Osaki, Shibuya, Ikebukuro, Yokohama, and Kawasaki Station Area as Special District for Urban Regeneration that promote TOD.

By prioritizing sustainable urban growth and efficient land use, Tokyo exemplifies how effective TOD can transform urban landscapes, making them more livable and accessible while addressing contemporary challenges such as congestion and environmental sustainability.

The **Tokyo Metropolitan Area** exemplifies effective **Transit-Oriented Development (TOD)**, particularly through its integration with the **Shinkansen** high-speed rail network. This development strategy began with the First National Capital Region Development Plan in 1958, aimed at managing postwar population growth and enhancing international competitiveness by aligning land use with transportation planning. As a result, Tokyo has successfully created a dense urban environment that prioritizes public transit, reducing reliance on automobiles.

In addition to Tokyo, the **Osaka Station** serves as a significant railway hub in the Umeda district, featuring an underground branch of the Tokaido Line that opened for passenger service on March 18, 2023. This station enhances connectivity within the Osaka metropolitan area by facilitating access to various train services, including the Tokaido Shinkansen, which connects Osaka with major cities like Tokyo and Kyoto.

These developments underscore the importance of integrating transportation infrastructure to accommodate rising automobile use while promoting efficient public transit options.

Figure 8 Japan railway use TDR

A key initiative in this context is **Japan Railway (JR) East's** use of **Transfer of Development Rights (TDR)** sales, allowing real estate developers to construct above railway properties. This strategy not only supports urban development but also addresses space constraints in the densely populated Tokyo area, further enhancing the effectiveness of TOD initiatives. Overall, these efforts demonstrate how strategic planning and investment in transportation infrastructure can lead to sustainable urban growth and improved quality of life for residents.

Figure 9 Himegi's TOD strategy

Himeji is an exemplary case of **Transit-Oriented Development (TOD)**, showcasing several key features that enhance urban living and connectivity. The city boasts **integrated transportation**, providing seamless connections between trains, buses, and pedestrian pathways, which significantly enhances accessibility for residents and visitors alike. Its **sustainable urban design** promotes a compact layout that encourages walking and the use of public transport, effectively reducing car dependency and fostering a healthier environment.

Moreover, Himeji's TOD strategy has led to **economic revitalization**, with business centers strategically located near transit hubs stimulating local economies and improving the quality of life for residents. The integration of **cultural elements** into public spaces reflects Himeji's rich history, creating a unique urban identity that attracts both locals and tourists.

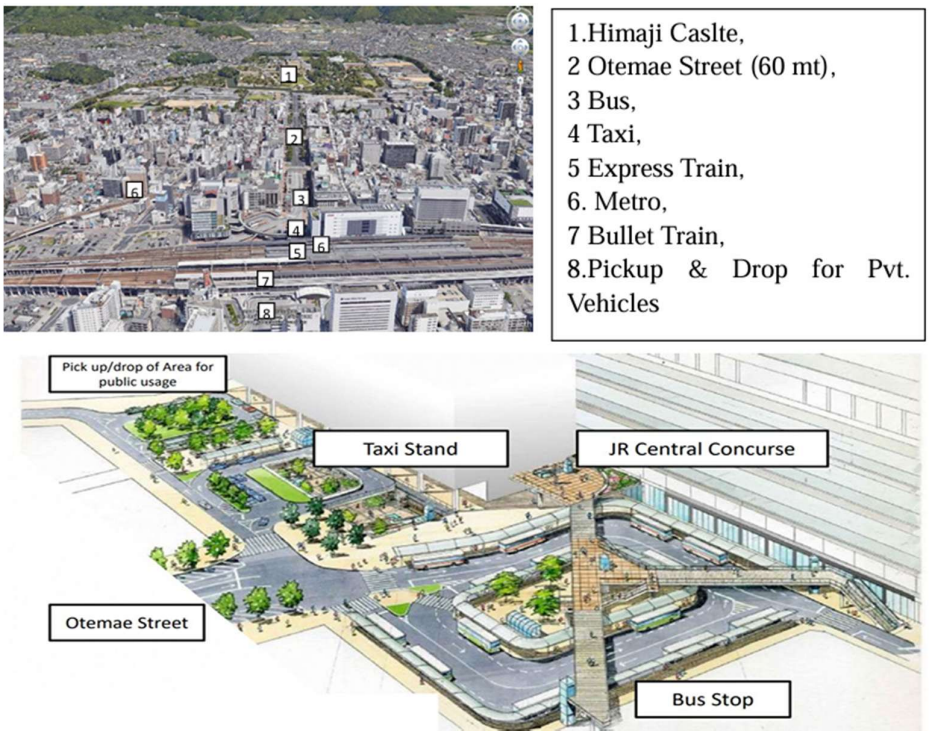


Figure 10 Sustainable Urban design and integrated Transport

Overall, Himeji serves as a model for successful TOD by demonstrating how integrated transportation systems, sustainable design, economic development, and cultural integration can work together to create vibrant and accessible urban environments.

Shinonome (Tokyo) is a district in Kōtō known for its effective **Transit-Oriented Development (TOD)**.

The area features high-density residential buildings and is served by **Shinonome Station** on the Rinkai Line, which promotes public transport use among residents. This TOD model enhances accessibility and encourages a shift away from automobile dependency.

In addition to its transportation infrastructure, Shinonome includes community spaces like **Canal Court Shinonome**, which fosters social interaction and walkability.

These elements contribute to a vibrant urban environment, making Shinonome a notable example of sustainable urban planning that prioritizes both mobility and community engagement.

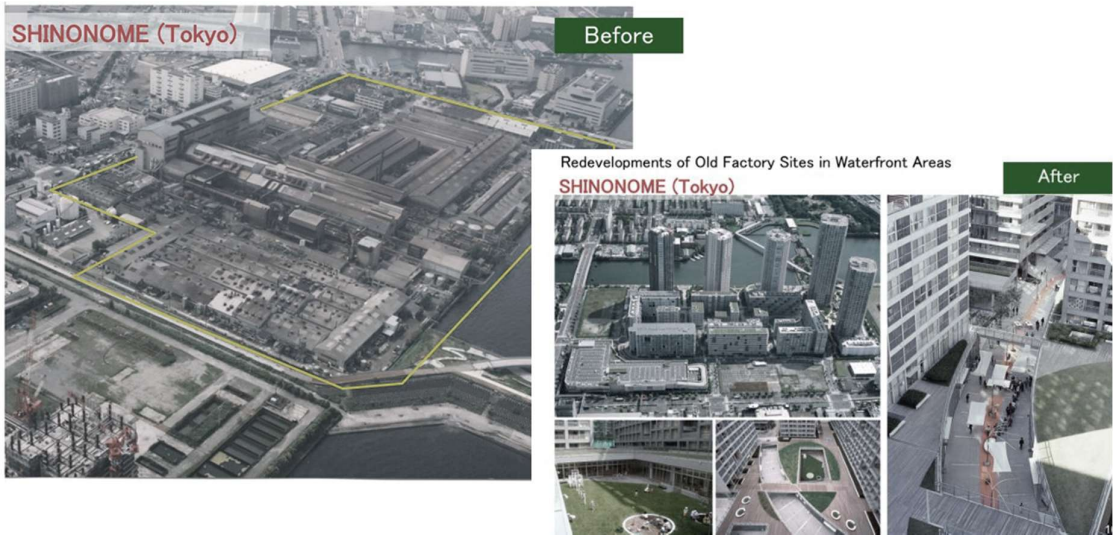


Figure 11 Shinonome (Tokyo) effective Transit-Oriented Development (TOD).

By integrating residential, commercial, and recreational spaces, Shinonome exemplifies how TOD can create livable neighborhoods that support public transit and enhance the overall quality of life for residents.

2.5 Case Study – GIFT City

Gujarat International Finance Tec-City (GIFT City) is India's first operational smart city and international financial services center, envisioned as a global hub for finance and technology.

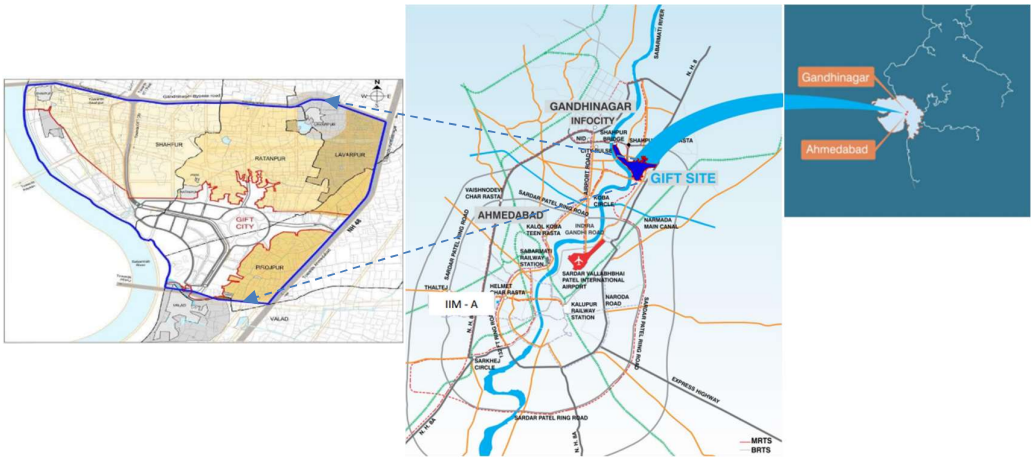


Figure 12 Location map of GIFT City

Strategically located between Ahmedabad and Gandhinagar, GIFT City is a flagship project initiated by the Government of Gujarat to position India on the global financial map. It is being developed through a Public-Private Partnership (PPP) model and is managed by GIFTCL (Gujarat International Finance Tec-City Company Limited), a joint venture between the Government of Gujarat—through the Gujarat Urban Development Company - and Infrastructure Leasing & Financial Services (IL&FS).

GIFT City is strategically located just 12 km from Ahmedabad International Airport and 6 km from Gandhinagar. Set on the banks of the Sabarmati River, it lies along the Delhi-Mumbai Industrial Corridor. The city will be connected by metro to Ahmedabad (approved by the Gujarat government) and is planned to have bullet train connectivity to Mumbai (under planning by the Government of India), ensuring seamless regional and national access.

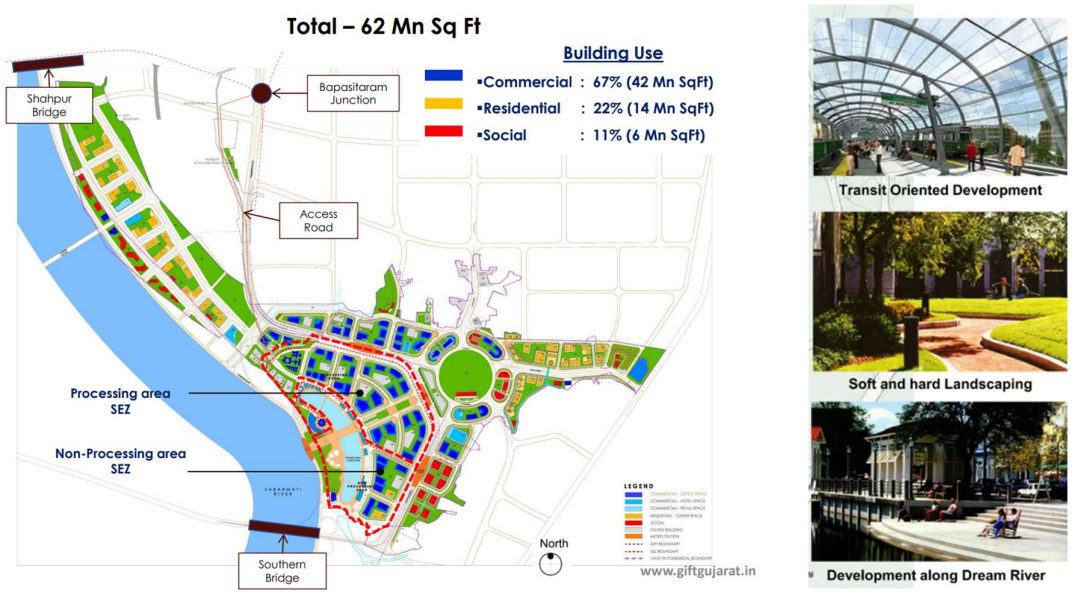


Figure 13 GIFT City master plan based on TOD Principles

Designed to meet international standards, GIFT City features world-class infrastructure, including high-rise commercial towers, residential zones, integrated transport systems, and a state-of-the-art utility tunnel. It houses India's first International Financial Services Centre (IFSC) and is envisioned to attract multinational banks, insurance firms, fintech companies, and other global institutions. GIFT City exemplifies innovation in urban planning, governance, and sustainable development.

GIFT City aims to capture 6–8% of emerging global business opportunities by offering a strategic location near Mumbai with excellent air and road connectivity. It features robust

urban planning, a well-structured urban form, and high-quality infrastructure, including advanced physical, ICT, and social facilities. A growing talent pool supports seamless business operations.

Figure 14 Schematic view of metro station at GIFT City

Designed as a global financial hub, GIFT City offers business-friendly regulations, an approved SEZ, and a clear implementation roadmap. The city's planning is based on Transit-Oriented Development (TOD) principles, emphasizing high-density growth around MRT stations with higher FSI/FAR. Commercial zones are concentrated along transit corridors to reduce vehicular dependency. Mixed-use developments integrate residential, office, retail, and recreational spaces within walkable distances of public transport, with MRT and BRT networks shaping sustainable and compact urban growth.

Table 4 Comparative analysis of different cities based on land area, scale, FSI and Green space

Feature	Paris (La Defense)	Tokyo (Shinjuku)	London (Dockyard)	Pudong (Lujiazui)	GIFT (India)
Land Area (Sq km)	1.6	1.6	1.05	1.7	3.58
Construction Scale (mn sq m)	2.5	1.6	1.1	4.5	8.5
Green Belt (1000 sq m)	40	120	50	363	1183
Height (m)	200	250	250	490	410

Planning Process

The **planning process** of GIFT City began with a strong **vision** to create a **high-density, mixed-use urban hub** based on **Transit-Oriented Development (TOD)** principles. The aim is to ensure **seamless connectivity**, **easy accessibility**, and **economic growth** by integrating land use and transport for a compact, efficient city.

During **master planning**, zones were designated for **commercial, residential, and institutional** uses. Areas near **transit nodes** were given **higher FSI/FAR** to promote **walkable, compact development** and reduce reliance on **private vehicles**. The plan supports **mixed-use development** to keep workplaces, homes, and amenities within close proximity.

A focus on **integrated mobility** ensures a **multi-modal transport system** with **MRT, BRT, pedestrian pathways**, and **last-mile connectivity**. This supports **smooth movement**, encourages **public transport use**, and enhances overall **urban sustainability**, making GIFT City a model for **smart, future-ready cities** in India.

GIFT City's development emphasizes **sustainable growth** by promoting **energy-efficient buildings**, **smart utility systems**, and ample **green spaces** to ensure long-term **environmental resilience**. The city integrates sustainability into its core planning to support a healthy, future-ready urban environment.

Table 5 Type of Business and their nature of opportunity

Business	Nature of Opportunity
Financial Services Operations	Back-office of banking, insurance, and asset management companies
Financial Services Corporate Center	Corporate roles in financial services companies, e.g., Accounting, HR, Admin, IT
Select Product Market	Private banking, product development, microfinance, etc.
Capital Market and Trading	Includes DCM, ECM, M&A, commodity trading, private equity, hedge funds, and institutional brokerage
IT Services	Software application development and maintenance for BFSI and other verticals
ITeS/BPO Services	Captive BPOs of large global financial services companies, 3rd party BPO service providers, KPOs, etc.

A strategy of **phased implementation** guides development, allowing the city to expand in line with **economic demand**, **population growth**, and **infrastructure readiness**. This approach ensures **flexibility** and **adaptability**, preventing overdevelopment and enabling efficient resource allocation.

To support rapid and stable growth, GIFT City has adopted strong **governance and policy measures**, including **special incentives**, a clear **regulatory framework**, and **investment-friendly policies**. These measures create a robust foundation for attracting global businesses and fostering economic activity.

Key Learnings from Case Studies

The comparative review of **Tokyo, Osaka, Himeji, Shinonome**, and **GIFT City** underscores several core principles crucial for effective **High-Speed Rail Station Influence Area (HSR-SIA)** planning. Foremost is the **strategic integration of land use and transportation**, seen in Japan through **multimodal transit hubs** and **compact, mixed-use developments** that reduce car dependency. **GIFT City**, though a greenfield project, applies similar **Transit-Oriented Development (TOD)** principles with **high FSI**, **zoning-based land use**, and **planned HSR-Metro linkage**. These approaches foster **dense, walkable neighborhoods**, efficient transit access, and a live-work-play environment.

Governance and policy also emerge as vital enablers. Japan's success is backed by **national frameworks**, such as the **Special Measures Act**, and tools like **Transferable Development Rights (TDR)**. Similarly, **GIFT City's SEZ status**, **Public-Private Partnership (PPP) model**, and **proactive policy support** ensure ease of implementation. Both emphasize **last-mile connectivity**, **pedestrian priority**, and **economic clustering** around transit. Together, these cases offer a blueprint for **holistic, context-specific planning**, guiding this study's proposal for creating **vibrant, resilient, and economically dynamic HSR-SIAs**.

Summary: This chapter establishes a strong theoretical base on HSR-Oriented Development (HSROD) and planning principles. By analyzing global trends, development models, and case studies from Japan and India, it identifies best practices for integrating HSR with urban planning to promote economic growth and sustainable development around HSR stations.

Chapter -3

3V FRAMEWORK AND INDICATORS

This chapter outlines the **HSR-TOD Evaluation Mechanism**, which forms the backbone of assessing development potential around High-Speed Rail stations. It introduces the **World Bank's 3V Framework**—**Node Value**, **Place Value**, and **Market Value**—as a comprehensive tool to evaluate transit influence zones. The chapter also presents a **three-pronged planning lens** covering **Land Use**, **Governance**, and **Finance**, and breaks down specific **indicators under each of the 3Vs**. These indicators serve to analyze connectivity, built environment, and real estate dynamics, helping guide context-sensitive planning around HSR stations.

3.1 HSR-TOD Evaluation Mechanism

High-Speed Rail (HSR) is emerging as a transformative force in urban planning and regional connectivity. The **HSR-TOD Evaluation Mechanism** serves as a critical tool to assess how effectively HSR projects support **sustainable urban growth** and integrated development.

A key focus is **Station Area Development**, which evaluates how well HSR station areas (HSR-SAs) are planned to support **high-density development**, **economic activity**, and **livability**. The mechanism also assesses **Connectivity and Accessibility**, ensuring HSR is seamlessly linked with **local transit**, **airports**, and **road networks** to enhance mobility.

The mechanism further examines alignment with **Sustainable Development Goals (SDGs)** by analyzing **carbon reduction**, **transit usage**, and **environmental impacts**. It includes an **Economic Impact Assessment** to measure benefits like **job creation** and **property value appreciation**. Additionally, it emphasizes **Community Engagement** to ensure local participation in planning, and supports **Long-Term Planning Frameworks** that align HSR with future **land use** and **mobility trends**.

This comprehensive approach ensures HSR projects are **effective**, **inclusive**, and **future-ready**. (Peifeng Zhang, 2020)

3.2 Evaluation Indicators for Transit-Oriented Development (TOD)

The **World Bank** has developed a publication focused on promoting inclusive and resilient **Transit-Oriented Development (TOD)** for its client countries, recognizing the diverse physical, social, and economic conditions present in each nation. This handbook tailors TOD strategies to meet the unique needs of different countries, addressing implementation challenges often overlooked in other resources. A key feature of this

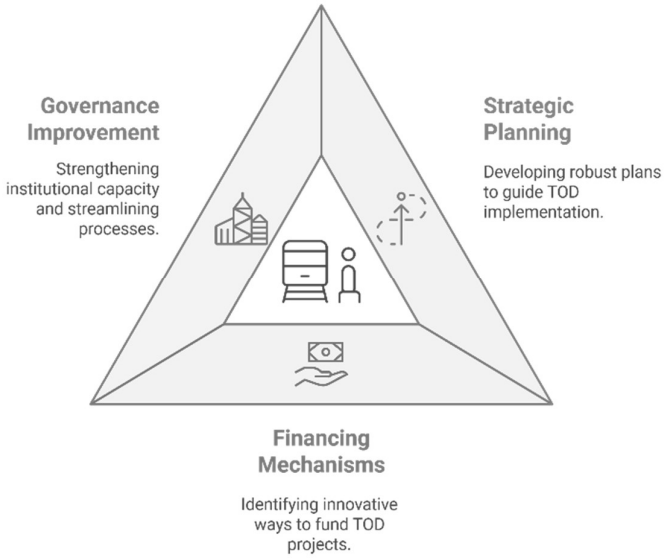

Governance Improvement
Strengthening institutional capacity and streamlining processes.
Strategic Planning
Developing robust plans to guide TOD implementation.
Financing Mechanisms
Identifying innovative ways to fund TOD projects.

Figure 15 TOD Implementation Resources & Tools

initiative is the **3V Framework**, which provides a methodology for analyzing a city's transit network in relation to its surrounding transit influence areas. The "3Vs"—**Node Value**, **Place Value**, and **Market Value**—help identify potential development areas within a city, making it particularly relevant for urban planning rather than comparing cities directly.

The framework is applicable to both large cities with extensive transit networks and smaller cities with limited mass transit options. It serves as an analytical tool where all sub-indexes are normalized to a value of one and aggregated using a weighted average method to derive final values for node, place, and market. This approach allows planners, political leaders, academicians, and consultants to assess the potential of TOD initiatives effectively.

By implementing the **5-step evaluation agenda** outlined in the handbook, stakeholders can better understand how TOD can foster sustainable urban growth, enhance connectivity, and improve the quality of life for residents. The emphasis on collaboration among various stakeholders further strengthens the potential for successful TOD implementation across diverse contexts. Ultimately, this resource aims to empower countries to harness the benefits of TOD while addressing local challenges and ensuring that urban development is inclusive and resilient. (Mehta, 2017)

3.3 Accelerating Urban Development: A Three-Pronged Approach to High-Speed Rail Oriented Development (HSROD)

High-Speed Rail Oriented Development (HSROD) enhances urban growth by integrating high-speed rail infrastructure with a focus on sustainable development. This approach involves three key components:

Planning and Land Use: HSROD emphasizes the establishment of **Transit Influence Zones** that promote mixed-use, high-density developments. This includes incorporating amenities for non-motorized transport, ensuring that communities are accessible and conducive to walking and cycling. By strategically planning land use around transit hubs, cities can optimize the benefits of high-speed rail, fostering vibrant neighborhoods that support both residential and commercial activities.

Institutions and Governance: Effective governance is crucial for the successful implementation of HSROD. The **Central Government** is responsible for setting overarching policies, while state governments manage land acquisition processes. Local bodies implement zoning regulations to guide development, and **Special Purpose Vehicles (SPVs)** coordinate efforts among various stakeholders. This collaborative governance structure ensures that all parties are aligned in their objectives, facilitating smoother project execution.

Finance and Funding Mechanisms: To fund HSROD initiatives, a variety of financial strategies are employed, including **Public-Private Partnerships (PPPs)**, government grants, **Land Value Capture (LVC)** mechanisms, and user charges. These funding

sources are essential for covering the costs associated with developing infrastructure and supporting sustainable urban growth. (ADB, 2022)

Key Performance Indicators for HSR-TOD

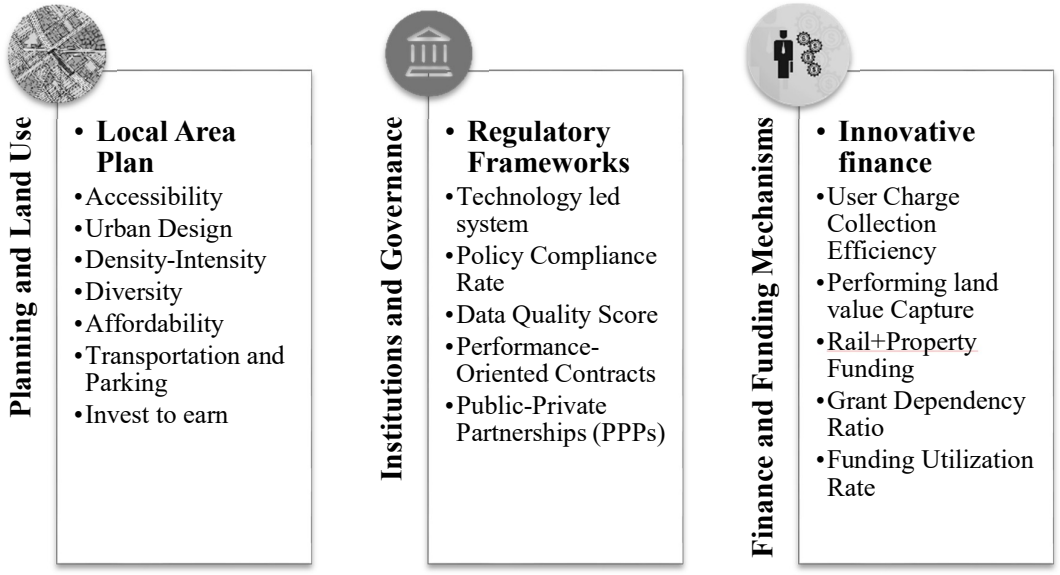


Figure 16 A Three-Pronged Approach to HSR-TOD

By integrating these three components—planning and land use, institutional governance, and financial mechanisms—HSROD can effectively accelerate urban development. This approach not only enhances connectivity through high-speed rail but also promotes sustainable practices that improve the quality of life for residents while addressing contemporary urban challenges such as congestion and environmental sustainability. Through careful planning and collaboration among stakeholders, HSROD can serve as a catalyst for transformative urban growth in regions served by high-speed rail networks.

3.4 Indicators on 3V Framework – Node, Place, Market

The Node, Place, and Market theory provides a robust framework for assessing the performance of Transit-Oriented Development (TOD) projects. By breaking down the evaluation into these three key dimensions, policymakers and planners can gain valuable insights into the project's potential for success.

Table 6 Indicators on 3V Framework

Category	Dimension	Indicator
Node	Traffic	Station Design Scale
		Station Passenger Flow
		Train Frequency
		Distance to Nearest Motorway Interchange
	Capacity to connect with city traffic	Number of Public Transport Lines
		Number of Public Transport Stations
		Public Transport Time to City Center
		Driving Time to Downtown
Place	The station's development location	Harmonization with Urban Space
		Spatial Compactness
	Functional Orientation	Functional Orientation of the Station Area
		Proportion of land for integrated transport facilities
		Proportion of land for industrial and logistics storage
	Development level of station cities	GDP of the city or county
		Population size of the city or county
		Per capita GDP of the city or county
		Public service level of the city or county
Market (Industry)	Industrial structure of the city or county	The ratio between the primary sector (A), secondary sector (I), and tertiary sector (S) of the city where the HSR station is located
	Potential for industrial agglomeration	Secondary industry enterprises' density
		Productive services enterprises' density
		Living services enterprises' density

The Node dimension focuses on the physical infrastructure of the station and its connectivity to the broader transportation network. **The Place dimension** evaluates the urban design and land use patterns around the station, emphasizing factors like density, mix-use development, and walkability. **The Market dimension** examines the economic potential of the station area, considering factors such as employment opportunities, commercial activity, and property values. By carefully analyzing these dimensions, stakeholders can make informed decisions to optimize the development of TOD projects and maximize their positive impacts on communities.

Table 7 3V Framework Indicators for study area

Category	Dimension	Indicator	Weightage	Rating - 1 (Very Poor)	Rating - 2 (Poor)	Rating - 3 (Moderate)	Rating - 4 (Good)	Rating - 5 (Excellent)
Node	Connectivity to Regional Network	Proximity to National/State Highway	0.15	> 2 km	1.5-2 km	1-1.5 km	0.5-1 km	< 0.5 km
		Distance to Nearest Urban Center	0.15	> 10 km	8-10 km	5-8 km	3-5 km	< 3 km
	Logistics Integration	Freight & Logistic Connectivity	0.2	No Access	Indirect via long route	Moderate linkage	Nearby Freight Hub	Direct Access to Freight
	Local Accessibility	Feeder Road/Last-Mile Access Potential	0.25	Poor or No Road	Minimal Access	Basic Road Present	Good Feeder Road	Excellent Last-Mile Grid
		Proximity to Institutions (Edu/Health)	0.25	> 10 km	8-10 km	5-8 km	3-5 km	< 3 km
Place	Land Potential	Land Suitability Class (from GIS)	0.25	Class 1 (Unsuitable)	Class 2	Class 3	Class 4	Class 5 (Highly suitable)
		Current Land Cover (Agri/Open/Built-up)	0.25	Waterbody/Forest/ Protected	Dense rural fabric, scattered plots	Mixed agri. and built-up	Agriculture near road/access	Open land or low-density agriculture
		Drainage/Slope Constraints	0.2	Severe constraint	Moderate-severe	Moderate	Minor constraint	No constraint
	Environmental Constraints	Environmental Buffers (e.g., ESZ, Flood zones)	0.15	Core buffer zone	Buffer edge	Near buffer zone	Minimal impact zone	Outside buffer
	Infrastructure Provision	Availability of Basic Infrastructure (Water, Sewer, Power)	0.15	Absent	Only 1 service available	2 services available	Basic infra available	Fully serviced and connected
Market	Sectoral Demand	MSME Sector Presence (by employment share)	0.25	< 5% MSME jobs in diverse sectors	5-10% MSME diversification	10-15% MSME diversification	15-25% MSME in multiple sectors	> 25% MSME share in diverse sectors
		Sector-wise Employment Gap or Growth	0.2	Declining or stagnant sector	Slow growth in secondary sectors	Moderate sectoral growth	High growth in agro/industrial services	High growth + future-ready sectors (clean

								tech, logistics)
	Workforce Readiness	Skilling Gap (ITI/Vocational Seats vs Demand)	0.2	High gap, < 1 seat per 1000 youth	Moderate gap, 1-2 seats per 1000 youth	3-4 seats per 1000 youth	5+ seats per 1000 youth, active training	Sufficient seats + placement networks
	Urban Pressure & Real Estate	Urban Housing/Service Demand Pressure	0.2	Low growth; no spillover from core city	Marginal spillover pressure	Growing demand, rising land interest	Consistent absorption in housing /services	High housing pressure and premium land value
	Investment Potential	Developer/Investor Interest (Trend-Based)	0.15	No interest observed	Limited or old proposals	Occasional project inquiries	Pre-commitments/land pooling interest	High investor/developer engagement

The **3V Framework** evaluates High-Speed Rail Station Influence Areas (HSR-SIAs) through three key dimensions: **Node**, **Place**, and **Market**. **Node** assesses **connectivity** via proximity to highways, urban centers, logistics, last-mile access, and institutions. **Place** examines **development suitability** considering land use, environmental constraints, and infrastructure availability. **Market** gauges **economic potential** using MSME presence, employment trends, skilling gaps, housing demand, and developer interest. Indicators are **weighted and rated**, providing a **quantifiable assessment** to guide targeted **planning** and **policy decisions** for effective HSROD.

Summary: This chapter established a robust analytical framework to assess **HSROD potential** using the 3V methodology. It detailed the **Node-Place-Market Value** approach and provided **indicator-based tools** aligned with planning, governance, and financial strategies. This structured evaluation method will support a **holistic and data-driven assessment** of the selected HSR station areas in the following chapters, laying the foundation for targeted planning interventions.

Chapter -4

OVERVIEW OF MAHSR CORRIDOR

This chapter focuses on the specific study area related to HSR development in India. It details the current state of HSR initiatives within the country and examines regional characteristics relevant to planning.

4.1 HSR Development In India

The development of High-Speed Rail (HSR) in India is a transformative initiative aimed at enhancing connectivity and promoting sustainable urban growth. Spearheaded by the National High-Speed Rail Corporation Limited (NHSRCL), the flagship project is the Mumbai-Ahmedabad High-Speed Rail (MAHSR) corridor, which spans approximately 508.09 km and is designed to operate at speeds of up to 320 km/h, significantly reducing travel time between these major cities to just over two hours.

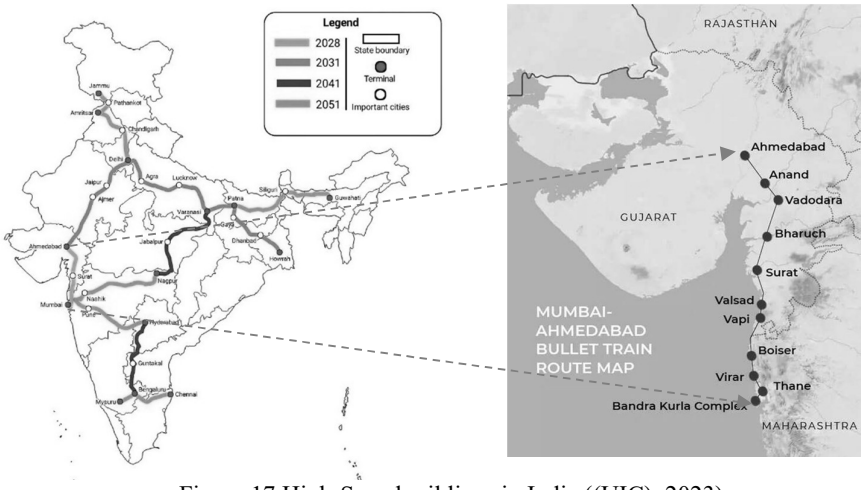


Figure 17 High-Speed rail lines in India ((UIC), 2023)

The MAHSR project, a result of a joint feasibility study conducted with Japan, commenced construction in 2017 and is expected to be completed by October 2028. This corridor will facilitate rapid transit and catalyze urban development in surrounding areas by creating High-Speed Rail Station Areas (HSR-SAs) that are strategically planned to accommodate high-density residential, commercial, and recreational spaces. The successful integration of HSR into India's urban landscape is anticipated to stimulate economic activities, enhance property values, and improve overall accessibility. Furthermore, the National Rail Plan outlines an ambitious vision for expanding India's HSR network, identifying thirteen

additional corridors that aim to connect major cities across the country. By leveraging global best practices in HSR development and focusing on effective urban planning strategies, India seeks to harness the full potential of HSR as a driver of economic growth and Sustainable urbanization *(Gupta, 2024)*

4.2 The HSR Station Area

High-speed rail (HSR) acts as a catalyst for urban development, attracting new socio-economic opportunities to a city. The **location of the HSR station** is crucial in determining the type of development it stimulates. To effectively plan for the developmental impacts of HSR-led urban growth, it is essential to identify the **influence area** of the station. Schutz (1988) categorizes the areas around an HSR station into three zones that benefit from the advent of HSR: **primary, secondary, and tertiary development zones**.

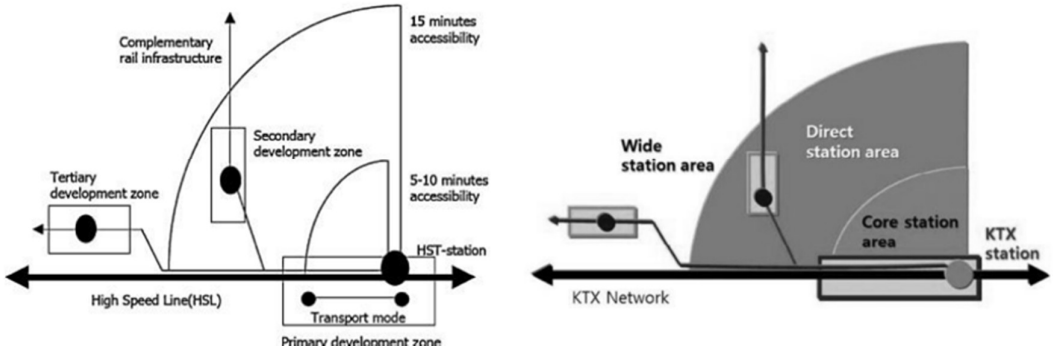


Figure 18 Identifying HSR Station Influence Area

Primary development zones are directly influenced by the proximity to the HSR station, benefiting from an enhanced status as a location. These zones are ideal for establishing high-grade office and residential functions, with high building density being a key aspect of development.

Secondary development zones may also host high-grade functions, though the real estate benefits are less pronounced compared to the primary zones.

Tertiary development zones support the primary zone by introducing complementary transport modes that serve other areas of the urban region. However, these zones are unlikely to exhibit direct development effects associated with the arrival of HSR services. For this study, the station area is identified based on Schutz's theory and adapted to the Indian context, considering suitable walking and driving distances. The **primary**

development zone is defined as the area within a 5-10 minute driving distance from the HSR station, approximately a 2 km radius. The **secondary station area** is identified as a circle with a radius of 500 m to 2 km from the HSR station. The **tertiary HSR station area** extends to a 15-minute drive or 5 km from the station. These defined areas are used to maximize the street network coverage for the study

Table 8 HSR Station influence Development zone

Zone	Accessibility to and from the HSR Station	Location Potential	Building Density	Development Dynamic
Primary Development Zone	Direct 5-10 min on foot or by seamless transport	Location for high-grade (international) functions	Very high	Very high
Secondary Development Zone	Indirect <15 min, by complementary transport modes	Secondary location for high-grade functions, Specialized functions related to specific location (cluster)	High	High
Tertiary Development Zone	Indirect >15 min, by complementary transport modes	Variety of functions depending on specific location factors	Depends on specific situation	Modest

4.3 Typology of Station Influence Area

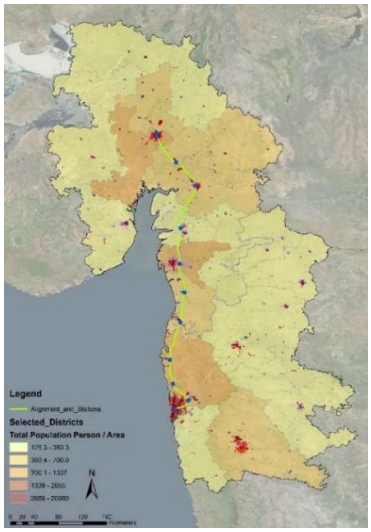


Figure 19 MA-HSR Corridor

Table 9 station name and its distance from previous station

	Name of Station	Distance in Km (Approx.)
Gujarat	Sabarmati to Kalupur	9
	Kalupur to Anand	30
	Anand to Vadodara	52
	Vadodara to Bharuch	76
	Bharuch to Surat	60
	Surat to Bilimora	52
	Bilimora to Vapi	51
Maharashtra	Vapi to Boisar	68
	Boisar to Virar	42
	Virar to thane	39
	Thane to Mumbai	29

The urban development impacts of the HSR station will shape the planning of the HSR station influence area. The existing urban context will present both challenges and opportunities for HSR-led development. Based on the identified area of influence, the urban context of the HSR stations on the **Mumbai-Ahmedabad High-Speed Rail (MAHSR) corridor** has been structured in a table. The broad parameters for analyzing

the urban context include the **character of the proposed station**, **connectivity of the station**, and **scale of the city**. Further study of the station area will identify the specific challenges and opportunities of each location.

4.4 Categorization of MAHSR Station

The Mumbai–Ahmedabad HSR corridor spans **two states**, with **8 stations in Gujarat** and **4 in Maharashtra**, each governed by state-specific planning regulations. The corridor supports two train types: **all-stop trains** and **rapid trains** halting only at key stations—**BKC (Mumbai), Surat, Vadodara, Ahmedabad, and Sabarmati**. **Mumbai and Sabarmati** serve as terminal stations, while **Mumbai and Ahmedabad** are expected to see the **highest ridership** due to their economic significance. **Surat, Vadodara, and Sabarmati** are projected to have **moderate ridership**, with estimates around **3922–5074 daily users**.

These parameters suggest that **Mumbai**, **Surat**, **Vadodara**, and **Ahmedabad** are the major stations on the MAHSR corridor, while the other eight stations have the potential to grow into larger urban centers following the operation of the MAHSR.

The location of the station within or outside the spatial extent determines whether it is a **brownfield** or **Greenfield** location.

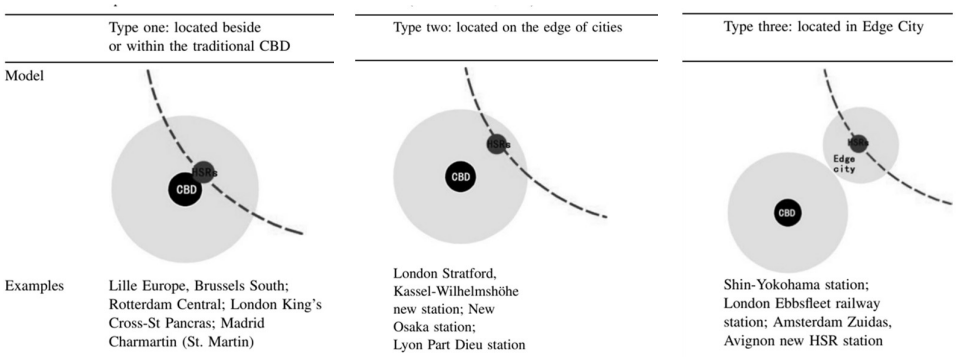

Type one: located beside or within the traditional CBD
Type two: located on the edge of cities
Type three: located in Edge City
Model
CBD
CBD
Edge city
CBD
Examples
Lille Europe, Brussels South; Rotterdam Central; London King's Cross-St Pancras; Madrid Charmartin (St. Martin)
London Stratford, Kassel-Wilhelmshöhe new station; New Osaka station; Lyon Part Dieu station
Shin-Yokohama station; London Ebbsfleet railway station; Amsterdam Zuidas, Avignon new HSR station

Figure 20 Models and examples of three kinds of HSR station location (based on Hall,2009)

Eight of the 12 stations are Greenfield locations, while four are brownfield locations. **Mumbai**, **Sabarmati & Kalupur (Ahmedabad)**, and **Vadodara** are brownfield locations. **Boisar** and **Bilimora** stations are not within any administrative jurisdiction, while other stations fall within the urban development authority jurisdiction or municipal boundaries.

4.5 Urban Growth Pattern around HSR

Table 10 Urban Growth Pattern –Demographic, economic, built around HSR

State	Station Name	District	Metro Area Population (million)	Estimated Ridership (pax/day)	City Population 2001	City Population 2011	City Population 2021	Population Growth Rate (2001–2021)	Estimated GDP Annual Growth Rate (2017–2022)	Estimated Per Capita Income (2023)	2023-2024	2003-2004
Maharashtra	Mumbai	Mumbai District	12.00	30,000 (2023), 158,000 (2053)	11,978,450	12,478,447	12,851,726	7.3%	7.6%	₹2,77,603	Mumbai /Thane/ Virar	
	Thane	Thane District	1.20	3,000 (2023), 16,000 (2053)	1,262,551	1,841,488	2,000,000	58.5%	7.5%	₹2,77,603	Boisar / Palghar	
	Virar	Palghar District	1.20	2,000 (2023), 11,000 (2053)	118,945	150,357	200,000	68.2%	6.5%	₹1,50,000	Vapi / Daman	
	Boisar	Palghar District	0.15	1,000 (2023), 4,000 (2053)	14,000	20,000	25,000	78.6%	6.5%	₹1,50,000	Surat / Navsari	
Gujarat	Vapi	Valsad District	0.16	2,000 (2023), 10,000 (2053)	112,000	163,630	200,000	78.6%	8.0%	₹2,50,000	Bharuch / Ankleshwar	
	Bilimora	Navsari District	0.05	1,000 (2023), 5,000 (2053)	51,211	55,000	60,000	17.2%	7.5%	₹2,50,000	Vadodara	
	Surat	Surat District	4.50	5,000 (2023), 24,000 (2053)	2,433,835	4,467,797	7,185,000	195.2%	11.5%	₹2,68,000	Anand / Nadiad	
	Bharuch	Bharuch District	0.22	1,000 (2023), 5,000 (2053)	148,391	169,007	200,000	34.8%	8.0%	₹2,40,000	Ahmedabad	
	Vadodara	Vadodara District	2.00	6,000 (2023), 31,000 (2053)	1,306,035	1,670,806	2,065,771	58.2%	8.5%	₹2,68,000		
	Anand/ Nadiad	Anand/ Kheda Districts	0.85	4,000 (2023), 18,000 (2053)	209,410	310,000	400,000	91.0%	9.0%	₹2,50,000		
	Ahmedabad	Ahmedabad District	6.30	21,000 (2023), 110,000 (2053)	3,520,085	5,570,585	8,450,000	140.0%	10.1%	₹2,68,000		
	Sabarmati	Ahmedabad District	—	3,000 (2023), 14,000 (2053)	—	—	—	—	10.1%	₹2,68,000		

4.6 Analyzing station development in Gujarat

Table 11 Analyzing HSR Ststion location and development in Gujarat

City	Station Type	Station Location	Accessibility	Concerned Authority	Mechanism to Plan	Organization Structure for Concerned ULB/UDA	Type of Land Development	Types of Investments	Examples from JAPAN	Authority boundary and station location
Ahmedabad	Brownfield	Within ULB	Public/Car/ Feeder Service	AMC and AUDA	Local Area Plan	Municipal Commissioner AMC	High Urban Renewal/Redevelopment projects	Activities associated to the closest CBD	Shin-Osaka	
Anand	Greenfield	Outside ULB	Low	None/ AVKUDA	TP Scheme	None	New Town, Industrial, Tourism location	Leisure & Tourism	Gifu-Hashima	
Vadodara	Brownfield	Within ULB	Public/ Commuter Rail/LRT	VMC and VUDA	Local Area Plan	Municipal Commissioner VMC	High Urban Renewal/Redevelopment projects	Knowledge-based activities, Innovation	Tokyo, Nagoya, Kyoto, Sendai	
Bharuch	Greenfield	Within UDA	Car/ Suburban-Commuter Rail/Feeder Service	BAUDA	TP Scheme	Bharuch Nagarpalika	High with tendency to form urban Sub-Centre	Tourism, Industrial, Commercial, New residential townships	Shin-Yokohama	
Surat	Greenfield	Within UDA	Car/ Suburban-Commuter Rail/Feeder Service	SUDA	TP Scheme	Chairman SUDA	High with tendency to form urban Sub-Centre	Tourism, Industrial, Commercial, New residential townships	Shin-Yokohama	
Bilimora	Greenfield	Outside ULB	Car/Feeder Service	None	TP Scheme	None	High with tendency to form urban Sub-Centre	Tourism, Industrial, Commercial, New residential townships	Shinagawa	
Vapi	Greenfield	Within ADA	Low	VAADA	TP Scheme	Town Planning Authority	New Town, Industrial, Tourism location	Leisure & Tourism	Gifu-Hashima	

The planning of High-Speed Rail (HSR) stations in India involves key factors such as station type, location, accessibility, and investment opportunities. There are two main types: **brownfield** (in existing urban areas) and **Greenfield** (in undeveloped regions). Accessibility through public transport, like feeder services, is crucial for ridership. Various planning mechanisms, including local area plans and urban renewal projects, are utilized based on the station context. Insights from Japan's Shin-Osaka and Tokyo stations provide valuable lessons for Indian planners.

4.7 Analyzing Quality of Life index

The planning of high-speed rail (HSR) stations in India focuses on several key factors that enhance quality of life (QOL). Economic opportunity is assessed through job availability and housing costs, while living and cultural opportunities examine access to essential services like healthcare and education. Amenities such as cleanliness and green spaces are evaluated, along with environmental burdens related to pollution. The Mumbai-Ahmedabad corridor, as a high-potential HSR project, aims to improve QOL by enhancing connectivity and stimulating local economies.

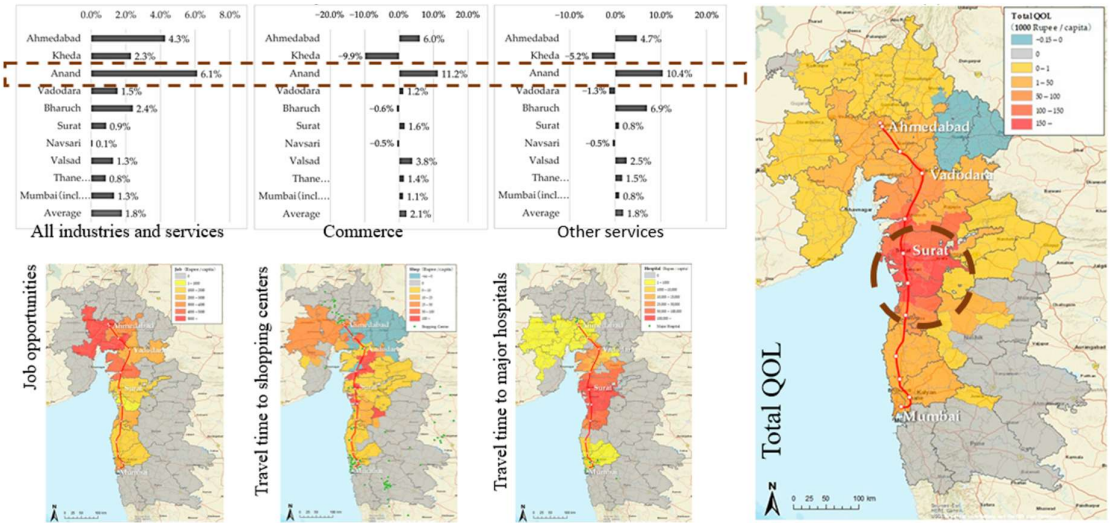


Figure 21 Quality of life Index

Summary: The examination of the study area contextualizes the theoretical discussions from previous chapters within India's unique urban landscape. It emphasizes that localized planning efforts are essential for realizing the benefits of HSR in enhancing connectivity and fostering economic growth.

Chapter -5
IDENTIFICATION OF STUDY AREA

This chapter outlines the identification of study areas for HSROD along the Mumbai-Ahmedabad corridor. It defines HSR Station Influence Areas (HSR-SIAs) using tailored theoretical frameworks and classifies stations by urban growth and development potential, leading to the choice of Anand/Nadiad and Surat as primary focus areas.

5.1 Introduction of study area

This study focuses on two strategically significant locations in Gujarat—**Surat** and **Anand/Nadiad**—positioned along the **Mumbai–Ahmedabad High-Speed Rail (HSR) Corridor**. These areas have been selected based on their diverse urban contexts and development potential, offering valuable insights into the application of **High-Speed Rail Oriented Development (HSROD)** principles.

Figure 22 Surat Economic Region

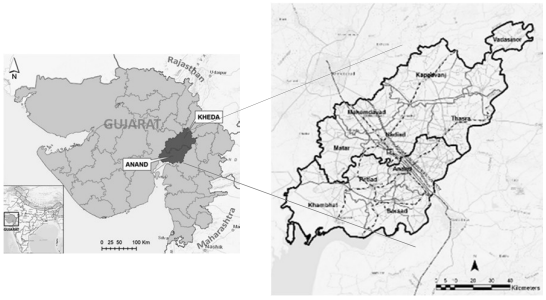


Figure 23 Charotar Region

Surat, an established industrial and economic hub, is currently preparing an **Economic Master Plan (EMP)** aimed at fostering innovation, diversifying its industrial base, and strengthening regional connectivity. Conversely, **Anand/Nadiad**, located in a predominantly Greenfield setting, presents an emerging growth node where the proposed

HSR station is expected to serve as a catalyst for **transit-oriented development (TOD)**. Together, these sites provide a comparative framework to assess the role of HSR in shaping urban form, guiding planned development, and supporting sustainable regional integration.

5.2 Regional and Urban context

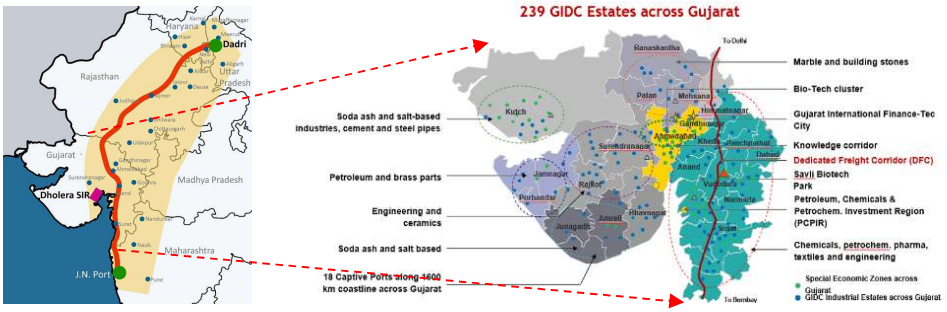


Figure 24 Economic Regions of Gujarat

Situated along the **Mumbai–Ahmedabad High-Speed Rail (HSR) Corridor**, both **Surat** and **Anand/Nadiad** occupy **strategically significant locations** within Gujarat's **north–south economic belt**. Their geographical positioning offers **critical connectivity** to key infrastructure networks, enabling each to play a **distinct role** in Gujarat's **urban and regional development**.

Surat, in **southern Gujarat**, is embedded within a **robust multimodal transport network** that includes **National Highway 48**, the **Western Dedicated Freight Corridor**, and proximity to **Hazira Port**. Its integration into the **Delhi–Mumbai Industrial Corridor (DMIC)** via the **Surat–Hazira investment node** strengthens its role as a **logistics and industrial powerhouse**. With a projected urban population of over **8.5 million**, Surat holds a dominant share in India's **textile** and **diamond** sectors, contributing significantly to both **regional** and **national economic growth**.

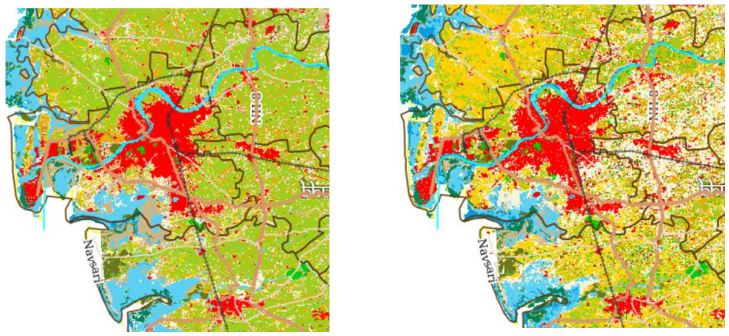


Figure 25 Urban Growth of Surat from 2003-2023

Anand/Nadiad, in **central Gujarat**, serves as an **emerging urban node**, positioned between the **Ahmedabad** and **Vadodara** metropolitan regions. It benefits from excellent regional access via the **Ahmedabad–Vadodara Expressway (NE-1)** and **NH-48**. **Anand**, known as the **"Milk Capital of India"**, hosts **Amul**, a key player in India's **dairy**

industry, while **Nadiad** is recognized for its growing base of **educational** and **healthcare institutions**. The upcoming **HSR station** enhances their potential as a **transit-oriented development (TOD) cluster**, offering opportunities for **compact, mixed-use urban growth**.

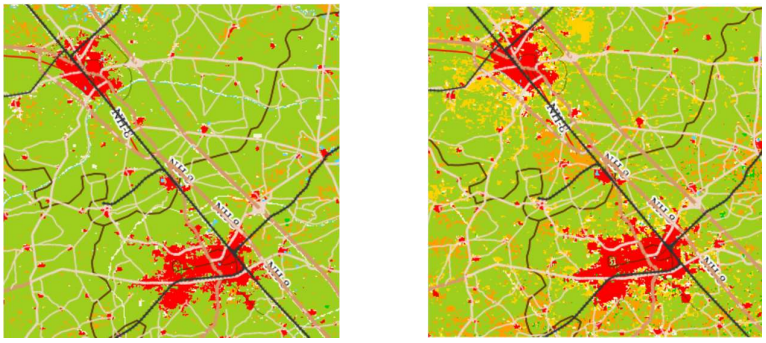


Figure 26 Urban Growth of Anand and Nadiad from 2003-2023

Together, these regions illustrate **contrasting yet complementary development trajectories**—**Surat** as a **mature industrial and economic center**, and **Anand/Nadiad** as a **Greenfield zone** primed for **HSR-induced transformation**.

5.3 Surat

Surat, the eighth largest city in India, is located in Gujarat, about 284 km south of Gandhinagar and 289 km north of Mumbai. Renowned as the **Diamond City**, it accounts for 90% of the world's diamond cutting and polishing and serves as a major hub for the textile industry. The city's transportation infrastructure includes a railway system established in 1860, which connects various regions and supports 245 bus routes, enhancing local mobility. Additionally, **Surat International Airport**, situated 11 km southwest of the city, further improves connectivity to South Gujarat. With its vibrant economy and significant industrial presence, Surat continues to attract businesses and residents alike.

Table 12 Surat economic region compare with Gujarat

Indicators	**SER**	**Gujarat**
Population 2023	15.7 Mn (~22%)	72 Mn (5%)
Area (Sq. Km)	21,217 (10.8%)	1,96,244 (6%)
GDP (current prices, FY23)	$ 72 Bn* (~25.6%)	$ 281 Bn (~8%)
GDP per capita (current prices, FY23)	$ 4,586* (1.17x)	$ 3,910 (1.5x)
Workforce (FY23)	7.7 Mn* (22.6%)	34 Mn (6%)
Worker Population Ratio (FY23)	48.9%*	47.2%

Table 13 Overview of Surat

Category	Surat City	Surat Metro-politan Region
Population in 2011 (2001)	4,462,002 (2,433,835)	4,585,367 (2,811,614)
Decadal Growth Rate (%)	83.3	63.1
Area (2011)	327 km²	4255 km²
Estimated Per Capita Income (2023) - Rs 200,000 - Rs 250,000		
Estimated GDDP at Current Prices (2022-2023) - Rs 5,00,000 crore		
Estimated GDDP Annual Growth Rate (2017-2022) - 10-12%		

Surat's transport systems have evolved significantly, with the road network expanding from 372 km in 1976 to 644 km in 1990, reflecting an annual growth rate of 18 km. Road travel remains the primary mode of transport, leading to challenges such as traffic congestion, air pollution, and noise pollution.

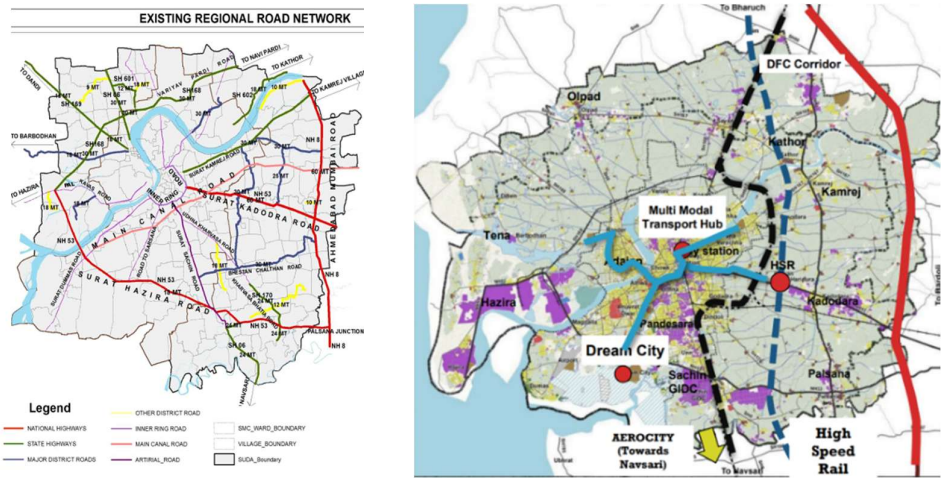


Figure 27 Surat Transport Network

The **Surat Railway Station**, established in 1860, connects various regions and supports a network of 245 bus routes that link major localities within the city.

Additionally, the public transport infrastructure is set to improve with proposals for a Bus Rapid Transit System (BRTS) and a city bus network aimed at enhancing connectivity and reducing reliance on private vehicles. Overall, Surat's transport framework is crucial for accommodating its growing population and economic activities while addressing sustainability concerns.

As is economic, infrastructure and sustainability diagnostics – Surat Economic Region

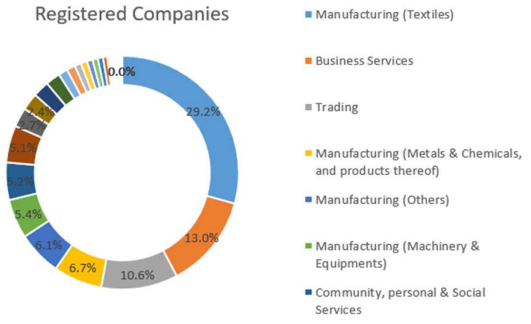


Figure 28 distribution of registered companies in Surat district

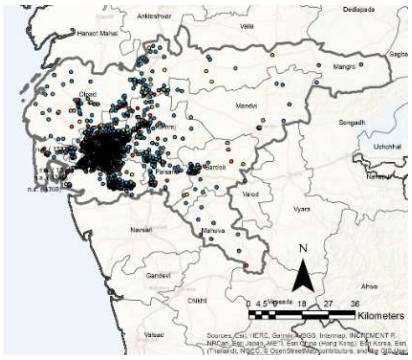


Figure 29 surat registered companies density map

Table 14 GDP and Employment of each sectors

Sector	GDP Current Prices, $Bn	Employment (Mn)
Agriculture & Allied	4	1.2
Mining & Quarrying	1	0.01
Manufacturing	40	3.3
Electricity, Gas, Water Supply & other utility services	2	0.05
Construction	2	0.1
Trade, Hospitality	8	1.6
Transport, Storage, Business Services & Public Administration	9	0.6
Commerce and services	1	0.03
Financial services	3	0.1
Other services	2	0.7

Registered companies in Surat district are primarily concentrated in Manufacturing (Textiles) at 29.2%. Business Services (13.0%) and Trading (10.6%) are also significant. Other manufacturing sectors include Metals & Chemicals (6.7%), others (6.1%), and Machinery & Equipment (5.4%).

Development Potential and Key Considerations

The **Surat station area** benefits from proximity to **DMIC**, **NH-48**, and existing **Town Planning (TP) Schemes**, making it a strong candidate for **mixed-use, high-density development**. With potential for a **secondary CBD**, Surat's development framework supports TOD through clear planning controls and connectivity provisions. However, challenges include **infrastructure phasing**, **institutional coordination**, and **urban integration** to avoid peripheral fragmentation.

5.4 Anand / Nadiad

Anand and Nadiad, located in central Gujarat along the strategic Ahmedabad–Vadodara corridor, are emerging as significant urban centers in the region. Known for their unique identities and complementary strengths, these twin cities contribute substantially to Gujarat's socio-economic landscape. Anand, famously recognized as the "Milk Capital of India," houses major institutions like Amul and the National Dairy Development Board (NDDB), playing a pivotal role in India's White Revolution. Nadiad, on the other hand, is distinguished for its prominence in education, healthcare, and administrative services, making it a vital urban node in the region.

Figure 30 Charotar Region

Table 15 Overview of Anand and Nadiad

Category	Anand City	Nadiad City
Population in 2011 (2001)	209,410 (160,662)	225,071 (192,913)
Decadal Growth Rate (%)	30.4	16.7
Area (2011)	47 km²	29 km²
Estimated Per Capita Income (2023)	Rs 150,000 – 200,000	Rs 150,000 – 200,000
Estimated GDDP at Current Prices (2022-2023)	Rs 25,000 crore	Rs 27,000 crore
Estimated GDDP Annual Growth Rate (2017-2022)	7-9%	6-8%

Together, these cities showcase a balanced urban character, driven by a blend of agro-industrial development, educational infrastructure, and growing urbanization. Supported by robust connectivity through railways and proximity to Vadodara and Ahmedabad Airport (approximately 50–60 km away). This growing urban synergy makes the Anand-Nadiad belt a key area for integrated development planning, especially in light of upcoming infrastructure like the Mumbai-Ahmedabad High-Speed Rail (MAHSR) corridor.

Anand–Nadiad Twin City Plan:

The Anand–Nadiad Twin City Plan, proposed by the Gujarat Infrastructure Development Board (GIDB), envisions integrated development of the two cities over a 25-year horizon

(till 2036). The plan aims to harness their individual strengths, enhance infrastructure, and boost economic growth by developing them as a cohesive urban entity.

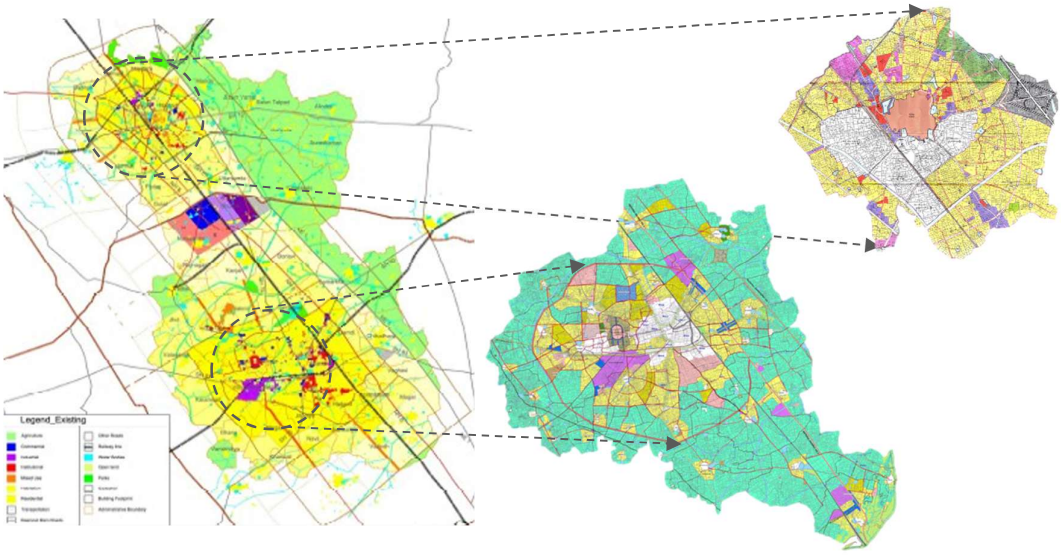


Figure 31 Anand & Nadiad Twin City draft development plan (2036), Anand and Nadiad Development Plan

Initially, the proposal faced challenges due to limited institutional capacity within the existing municipal structures. However, following the successful model of the Ahmedabad–Gandhinagar twin city, the idea gained renewed momentum. In 2022, Prime Minister Narendra Modi announced the replication of this model across Gujarat, including Anand–Nadiad. With both cities attaining Municipal Corporation status in 2024, the groundwork was laid for effective implementation of the twin city plan.

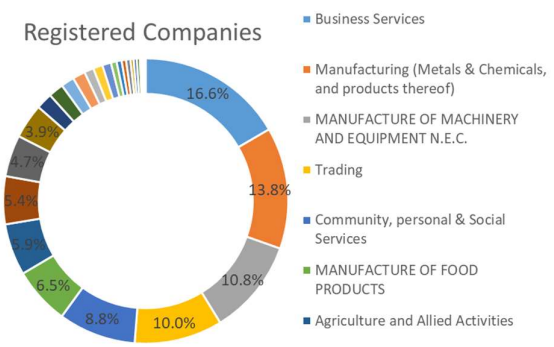


Figure 32 Registered companies distribution in charotar region

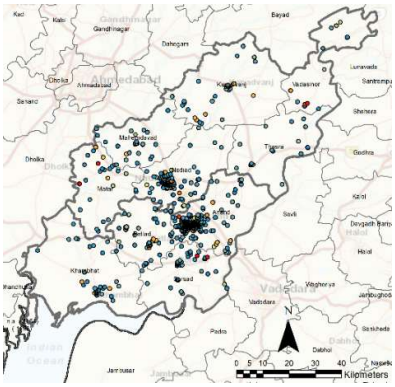


Figure 33 Anand and Kheda district registered companies' density map

In Anand and Kheda districts, the business landscape is led by the **Business Services** sector, accounting for **16.6%** of registered companies. This is followed by **Manufacturing of Metals, Chemicals, and related products** (13.8%), **Machinery and Equipment**

N.E.C. (10.8%), and **Trading** (10.0%). Other key sectors include **Community and Personal & Social Services** (8.8%), reflecting a diverse and growing economic base.

Table 16 Industrial profile of Anand and Kheda District

Head	**Anand District**	**Kheda District**
Registered Industrial Unit	7,737	738
Registered Medium & Large Unit	72	16
Estimated Average No. of Daily & Worker Employed in Small Scale Industries	43,415	12,089
Employment in Large & Medium Industries	7,830	6,814
Turnover of Small Scale Industries - 21,602.55 Rs. (in Lacs)		
Turnover of Medium & Large Scale Industries - 77,836.31 Rs. (in Lacs)		

Development Potential and Key Considerations

The **Anand/Nadiad station area**, though Greenfield, has significant **growth potential** due to its **bi-nodal urban catchment** and regional connectivity. While lacking a dedicated Economic Master Plan, it falls under active jurisdictions like **Anand and Nadiad UDAs**, enabling implementation through **TP Schemes**, **DCRs**, and **future LAPs**. The key challenge lies in **coordinated planning** across jurisdictions and aligning **infrastructure timelines** with projected growth.

Summary: The chapter provides a comprehensive overview of HSR progress in India, with a focus on the MAHSR corridor. It systematically defines and delineates HSR-SIAs and classifies stations by typology (Greenfield/Brownfield, major/minor). Through detailed analysis of urban growth and station characteristics, Anand/Nadiad and Surat are identified as key study areas, establishing the spatial framework for focused planning and development interventions.

Chapter -6

ASSESSMENT OF STATION AREA

This chapter offers a detailed assessment of the Surat and Anand/Nadiad High-Speed Rail station areas using a comprehensive HSROD planning framework. It presents the growth vision and strategic alignment for Local Area Plans, supported by the 3V Framework analysis, Location Quotient economic base study, and land suitability mapping. Stakeholder inputs are integrated to refine zoning and development priorities.

6.1 Framework for HSR-Oriented Regional Planning and Development

High-Speed Rail-Oriented Regional Development
Diagnostics of Existing Conditions
Assess economic, infrastructure, and sustainability aspects within HSR influence areas.
Visioning and Future Projections
Project regional growth scenarios for 2035 and 2047 with HSR as a catalyst.
SWOT and Regional Endowment Analysis
Identify key economic sectors that can thrive with HSR connectivity.
Focus on Key Growth Sectors
Detail strategic sectors for HSR-influenced development, considering infrastructure needs.
Implementation Framework and Governance
Develop organizational and financial strategies for HSR development.

Figure 34 HSR oriented Regional Development

The assessment around **High-Speed Rail (HSR) nodes** focuses on evaluating the **economy, infrastructure, and sustainability potential** of the region. Key parameters include analysis of **GDP, employment trends, land use patterns**, and emerging **net-zero opportunities**. Growth projections are established for the years **2035 and 2047**, aligning with national development targets. The framework sets **sustainability, infrastructure, and development goals**, while identifying **top 10 growth drivers** across **7–10 priority sectors** such as **tourism, logistics, healthcare, and agri-business**. A detailed **SWOT analysis** and **regional endowment mapping** support this evaluation. The strategy outlines **investable projects**, backed by measurable **Key Performance Indicators (KPIs)**, and recommends **governance and funding mechanisms** including **PPP models, bonds, and multilateral financing**. Clear **leadership roles** and **institutional structures** are proposed to ensure streamlined planning and execution.

Guiding principle for Regional Development Planning

The **Economic Master Plan** is guided by three interconnected pillars that ensure balanced and future-ready development. The first, **Economy & Investment**, emphasizes the creation of **integrated economic hubs** with **global and regional relevance**, targeting **high employment generation**.

The second, **Quality of Life & Inclusivity**, focuses on building **equitable opportunities across genders** and ensuring a **world-class living environment**.

The third, **Promoting Sustainability**, prioritizes **decarbonization, climate resilience**, and the development of **sustainability lighthouses** to model responsible growth. The integration of these three pillars is essential to achieving **holistic and sustainable urban development**.

6.2 Surat– Growth Vision and Strategic Alignment for HSROD LAP

The **Growth Vision for Surat** under the HSROD Local Area Plan (LAP) aims to transform the city into a **transit-integrated economic powerhouse** leveraging high-speed rail connectivity.

Table 17 Surat– Growth Vision and Strategic Alignment for HSROD LAP

Aspect	Details
Vision 2047	Position Surat as a global economic hub driven by manufacturing, services, tourism, and real estate, anchored by world-class infrastructure.
Economic Growth Target	₹1.5 Trillion GVA (Gross Value Added) by 2047 (7–8% CAGR needed).
Job Creation Target	Additional 2 Million jobs by 2047, with 65% employment expected from services and real estate sectors.
Enabler Sectors	**Healthcare Infrastructure** (Tertiary and quaternary care hospitals) **Higher Education (Edu-City)** (Skill development to meet sector demand) **Integrated Logistics and Warehousing** (Industrial-grade logistics parks)
HSR Strategic Role	Surat HSR Station catalyzes regional and global trade integration, enhancing Surat's competitiveness in finance, business services, tourism, and advanced manufacturing.
Urban Planning Direction (for HSROD)	Retrofit-based densification around Surat HSR influence area, integrating business hubs, service sectors, residential corridors, and mobility systems under TOD and HSROD principles.

Surat: Strategic Infrastructure & Economic Growth

Surat is emerging as a **key economic corridor** with major infrastructure projects enhancing **connectivity** and **industrial capacity**. Projects like the **Mumbai–Ahmedabad**

High-Speed Rail (HSR), **Dedicated Freight Corridor (DFC)**, **Delhi–Mumbai Expressway**, and **Surat Metro** are boosting **transport efficiency** and **urban mobility**. Industrial hubs such as **DREAM City**, **Surat Industrial Growth Region (SIGR)**, and **PM MITRA Textile Park** drive **economic diversification** and **job creation**. The **Surat International Airport expansion** and port upgrades at **Hazira** and **Dahej** strengthen the city's role in **trade and logistics**

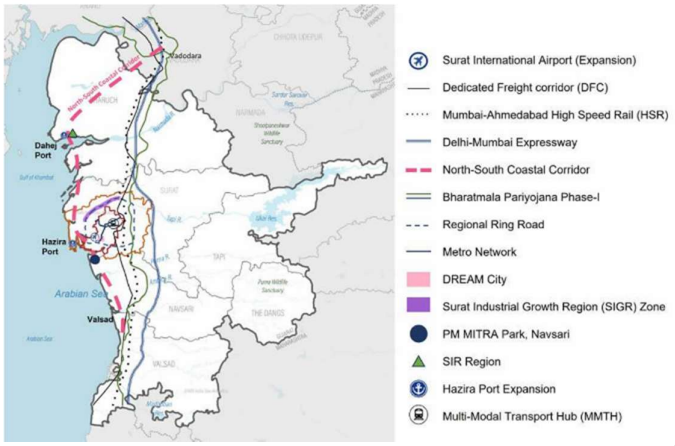


Figure 36 Ongoing and proposed mega infrastructure projects

Figure 37 HSR Zone

HSR Zone, Surat
Total Area: 2000 acres (~8 sq.km) Estimated Investment: $1 Billion
Develop a **B2B Zone** for Textile & Apparel (T&A) and Gems & Jewelry (G&J) sectors, modeled on the successful **Guangzhou wholesale trading concept**, while ensuring compliance with environmental norms.

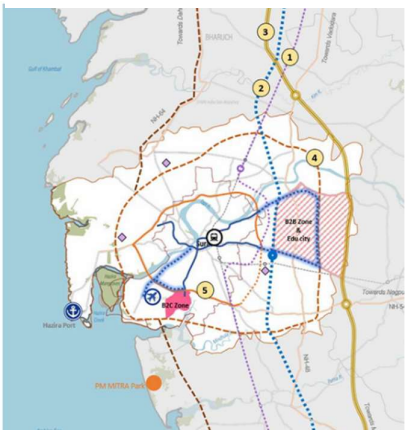


Figure 35 B2B Zone and Edu City

Key Components of Proposed Development

The proposal envisions an **integrated economic hub** featuring **FTWZ-model wholesale markets**, **warehouses**, **business hotels**, **malls**, and **healthcare facilities**. It includes **dedicated housing** for workers and executives, along with **multi-modal transport options** such as **shuttles**, **helipads**, and **vertiports**. With **seamless connectivity** to **DREAM City**, **Surat International Airport**, and **manufacturing hubs**, the area supports an **end-to-end business ecosystem** with **trade facilitation**, **cataloguing**, and **e-commerce integration**.

6.3 Activity Determination – Surat HSR Station

Proposed LAP Zoning Structure and Sectoral Allocation – Surat HSR Influence Zone

Table 18 Proposed LAP Zone Core Activities

Proposed LAP Zone	Core Activities	Suggested Land Share (%)
B2B Trade and Wholesale Hub	Textile & Apparel (T&A), Gems & Jewelry (G&J) trading centers, wholesale markets, FTWZ model warehouses	30%
Financial and Business Services Zone	Financial services, offices, business parks, service-sector hubs	20%
Higher Education and Skill Development Zone (Edu-City)	Universities, R&D centers, skill development institutes	15%
High-Density Residential Cluster	Walk-to-work housing, affordable urban apartments, residential towers	15%
Healthcare and Wellness Zone	Multi-specialty hospitals, medical research centers, health tourism support	10%
Civic and Public Amenities Zone	Civic utility centers, administrative complexes, urban amenities	5%
Public Green and Open Space Zone	Urban parks, landscape buffers, riverfront recreation spaces	5%

LAP Delineation Parameters – Surat HSR Influence Zone

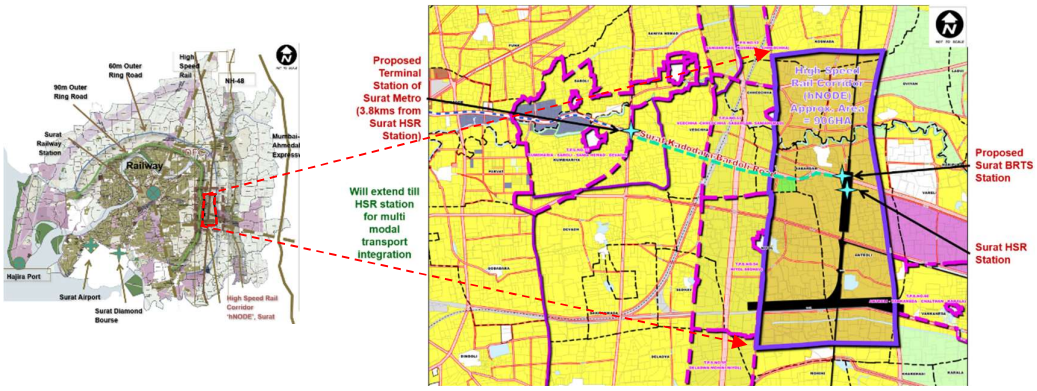

Proposed Terminal Station of Surat Metro (3.8kms from Surat HSR Station)
Will extend till HSR station for multi modal transport integration
Proposed Surat BRTS Station
Surat HSR Station
Railway
Surat Airport
Hajira Port
Surat Diamond Bourse
NH-48

Figure 38 LAP Area Delination

The **Surat HSR Station near Antroli** anchors a **2–3 km influence area**, covering key urban nodes like **Kosmada, Valthan, Vareli, Kadodara, and Maripur**. The zone connects to **Metro Phase-1**, **BRTS corridors**, **NH network**, and strategic hubs like **DREAM City** and **Surat Airport**.

Guided by the **Surat Economic Master Plan**, the zone emphasizes sectors like **B2B trade, finance, housing, and logistics**. The core objective is to integrate the **HSR station with the existing urban fabric** using **TOD principles**, while ensuring **strategic linkages** to **DREAM City**, **Surat Airport**, and **freight corridors** for seamless regional integration.

6.4 Land Suitability Analysis – Surat HSR LAP Area

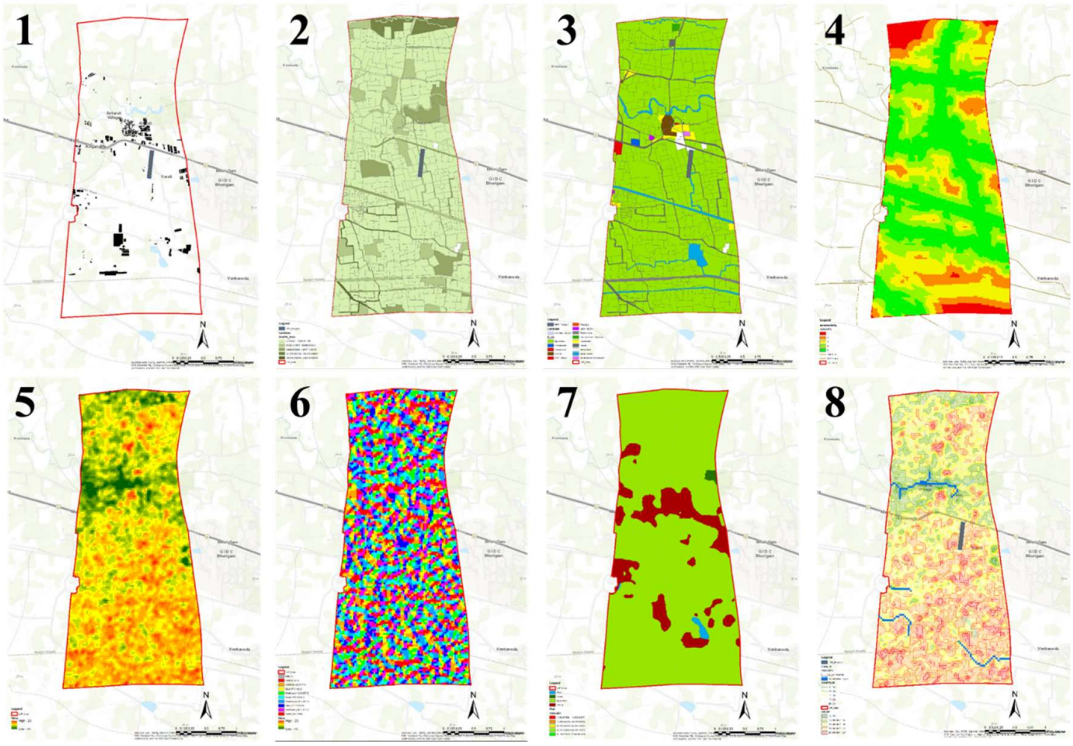


Figure 39 **1**- Built-up, **2**-Plot pattern, **3**-Land use, **4**-Accessibilty, **5**-Slope, **6**-Aspect, **7**-Land Cover, **8**-Natural Drainage

Key Parameters Used:

The land suitability analysis used multiple maps for clear assessment. **Map 1** shows existing built-up areas excluded from development. **Map 2** outlines plot patterns for land availability. **Map 3** highlights land use, prioritizing open/agricultural land. **Map 4** ranks accessibility near roads and transit. **Map 5** and **Map 6** analyze slope and terrain aspect, favoring flat areas. **Map 7** depicts land cover, restricting dense vegetation. **Map 8** marks natural drainage buffers as no-development zones.

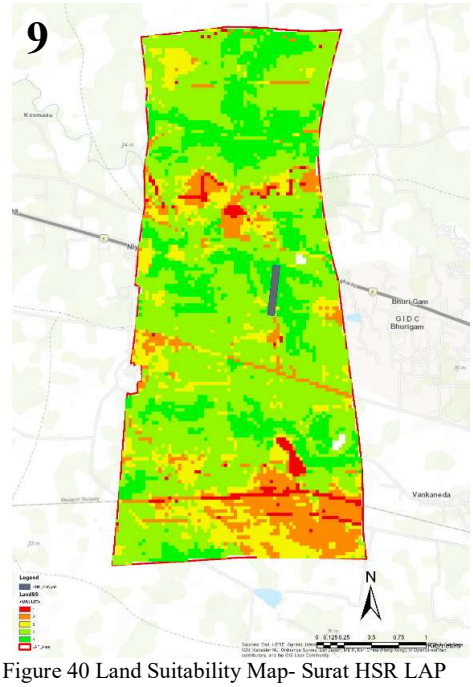


Figure 40 Land Suitability Map- Surat HSR LAP

Finally, all these layers were integrated using a **weighted overlay method**, as shown in **Map 9**, resulting in a **composite Land Suitability Index** that informed the optimal zones for Local Area Plan (LAP) delineation under the HSROD framework.

6.5 Anand / Nadiad

Anand–Nadiad is a key urban-economic corridor in Gujarat, strategically located between major city clusters. It is well-connected by the Mumbai–Ahmedabad High-Speed Rail, NH-64, SH-60, SH-83, and Vadodara–Ahmedabad Expressway, forming a vital multimodal corridor.

LAP Delineation Parameters –

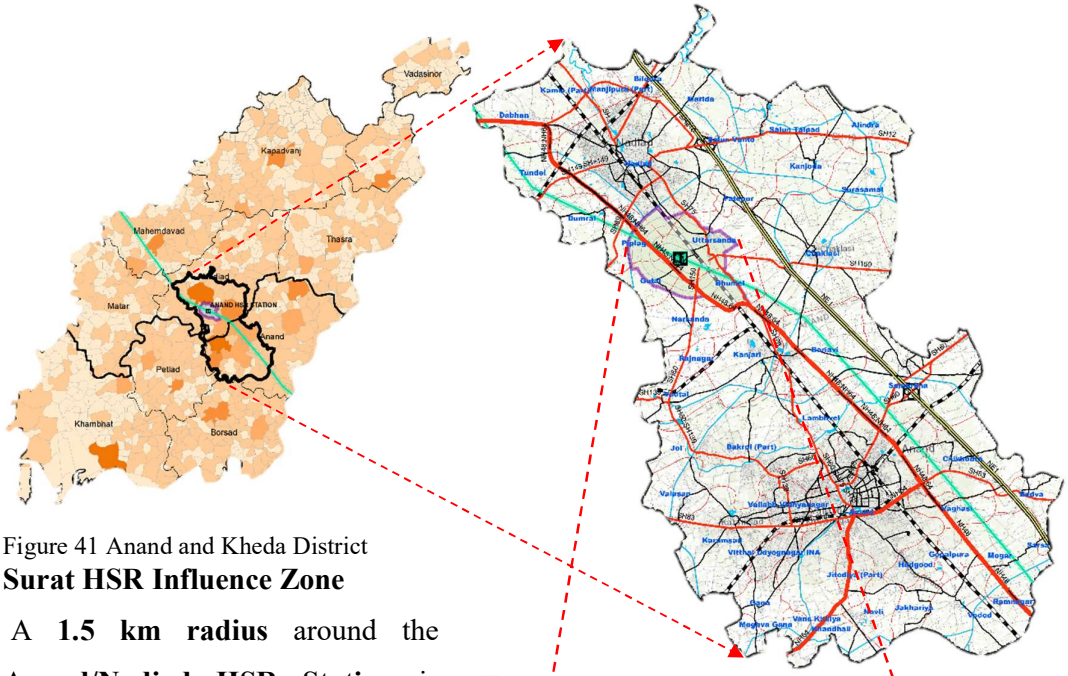


Figure 41 Anand and Kheda District

Surat HSR Influence Zone

A **1.5 km radius** around the **Anand/Nadiad HSR Station** is designated as the **core planning area**, aligned with **TOD standards**. This zone encompasses **urban and peri-urban areas** near key **roads** and **institutions**, making it ideal for **high-speed rail–oriented development**. The **LAP boundary** was defined based on **connectivity** to HSR and highway infrastructure, inclusion of **Gamtal villages** (Uttarsanda, Guntal, Narsanda) for **integrated planning**, and the availability of **contiguous developable land parcels**.

Figure 42 Anand-Nadiad Twin City

Figure 43 Anand HSR LAP Area

6.6 Stakeholder Consultations for Anand/Nadiad HSR Station Area Planning

Nadiad Municipal Corporation

The Nadiad Municipal Corporation confirmed that the HSR station is located within its municipal limits and expressed support for a mixed-use Local Area Plan (LAP) focused on **education, healthcare, and residential development**. They are open to adopting **TOD zoning** and modifying town planning boundaries, provided that these changes are backed by a robust proposal. The corporation emphasized the critical importance of **multimodal connectivity**, including seamless integration between the HSR terminal, the existing railway station, and the city road network.

Anand Urban Planning Expert

Despite the station being outside Anand's municipal boundaries, Anand's urban planning expert highlighted its strong **regional economic influence** on Anand. The expert recommended the LAP prioritize **agro-processing, education, and institutional expansion** while ensuring the plan aligns with **TOD principles** through **walkable mixed-use layouts**. They stressed the need for effective **inter-municipal coordination** between Anand and Nadiad to leverage regional synergies and suggested incorporating Anand's well-established **dairy and research-based economy** into the zoning framework.

NHSRCL Station Development Division

The NHSRCL identified the HSR station as a **Greenfield site** suitable for comprehensive station area planning. They proposed anchoring the development on key sectors such as **agro-tech, institutional and skill development hubs, healthcare facilities, and TOD-based housing**. They advocated for the use of **value capture mechanisms** like Transfer of Development Rights (TDR) and **public-private partnerships (PPP)** to finance development. Emphasis was placed on **pedestrian-friendly design**, efficient **last-mile connectivity**, and strong **multi-agency collaboration**. Furthermore, NHSRCL stressed the necessity for LAP proposals to be consistent with **regional policies** and **feasibility assessments** to ensure practical implementation.

Expert-Based Zoning Prioritization for LAP

Expert ratings (1–5) guided zone prioritization based on suitability and planning goals. **Institutional areas** (4.6) and **Urban Logistics** (4.5) emerged as top priorities, aligning with Anand's academic and clean-industry profile. **Walk-to-Work Housing** (4.2) and **Public Greens** (4.5) support TOD goals, while **Drain Corridors** (4.2) are essential buffers. **MSME/Clean-Tech zones** (2.5) were less suitable due to industrial limitations. **Civic facilities** (3.2) were deprioritized due to existing supply. **Infrastructure reserves** were marked as essential for LAP feasibility.

Table 19 Expert-Based Zoning Prioritization for LAP

Zone	Sub-Zone / Function	Expert Avg. Rating (1–5)	Planning Interpretation
Public / Semi-Public	Institutional (Education, Skilling, R&D)	4.6	High priority due to Anand's academic legacy; aligns with long-term growth
	Health & Allied Services	4.0	Supports regional wellness and health infrastructure gaps
	Civic / Administrative Facilities	3.2	Deprioritized as such facilities already exist in Anand & Nadiad core
Residential (High-Density TOD)	Mid-/High-Density Walk-to-Work Housing	4.2	Needed for service workforce & professionals; excludes affordable/EWS zones
Commercial	Financial / Business Services Cluster	4.1	Office parks, consulting, B2B hubs — moderate priority sector
Logistics & Warehousing	Urban Logistics & Aggregation (non-polluting)	4.5	High suitability near SH/NH; no processing or heavy handling included
Recreational / Green Buffers	Ecological Drain Corridors	4.2	Mandatory to preserve natural flows and slope pattern
	Urban Open/Public Greens	4.5	Needed for TOD environment, heat management, and walkability
Industrial	MSME / Clean-Tech Incubation (Low-Impact)	2.5	Regional demand acknowledged, but area not suitable for industrial land use
Road & Infrastructure Reserve	ROWs, Utility Corridors, Access Networks	NA	Considered baseline and non-negotiable in any LAP proposal

6.7 3V Framework Assessment – Anand/Nadiad HSR Station

The **3V assessment** evaluates the station area across **Node**, **Place**, and **Market** dimensions using **15 weighted indicators**. Based on **secondary data**—including proximity to infrastructure, land condition, and economic trends—it informs LAP priorities. This integrated approach ensures **data-driven zoning** and **targeted planning interventions.**

Table 20 3V Framework Assessment – Anand/Nadiad HSR Station

Category	Indicator	Weight	Score	Weighted Score	Category Score
Node	Proximity to NH/SH	0.15	5	0.75	3.95
	Distance to Urban Center	0.15	4	0.60	
	Freight Connectivity	0.20	3	0.60	
	Feeder Road Access	0.25	4	1.00	
	Proximity to Institutions	0.25	4	1.00	
Node Value is **moderate (Score: 3.95)** due to good road access but weak last-mile and freight connectivity. Planning must focus on **B2B freight terminal**, **feeder road upgrades**, and **HSR–highway integration**.					
Place	Land Suitability	0.25	4	1.00	4.25
	Current Land Cover	0.25	5	1.25	
	Drainage/Slope Constraints	0.20	4	0.80	
	Environmental Buffer	0.15	5	0.75	
	Basic Infrastructure	0.15	3	0.45	
Place Value – Highest Priority (Score: 4.25): Dominated by open or low-density agricultural land with minimal environmental constraints. Prioritize zoning for **urban housing**, **institutional campuses**, and **public amenities**.					
Market	MSME Sector Presence	0.25	5	1.25	4.05
	Sectoral Employment Gap	0.20	4	0.80	
	Skilling Gap	0.20	3	0.60	
	Urban Housing Pressure	0.20	4	0.80	
	Investor Interest	0.15	4	0.60	
Market Value – Strong Support (Score: 4.05): With 7,737 MSMEs and a strong agro-dairy base in Anand, the area has a ready workforce pipeline. Prioritize zoning for **agro-processing hubs**, **MSME parks**, and **skill-tech campuses**.					

Anand/Nadiad station exhibits **high Place and Market potential**, with a need to **strengthen Node value** through multimodal transport planning in the LAP.

6.8 Economic Base Analysis using Location Quotient (LQ)

The **Location Quotient (LQ)** is a statistical tool that measures the **relative concentration of a sector or industry** in a specific local area compared to a broader reference region (e.g., state or country). It helps identify **key economic strengths or specializations** of a region.

The formula is:

LQ = (E_local_sector / E_local_total) ÷ (E_reference_sector / E_reference_total)

Where:

E_local_sector = Employment in the sector in the local area

E_local_total = Total employment in the local area

E_reference_sector = Employment in the same sector in the reference region

E_reference_total = Total employment in the reference region

An **LQ > 1** indicates **higher local concentration**, suggesting a **regional economic advantage** in that sector.

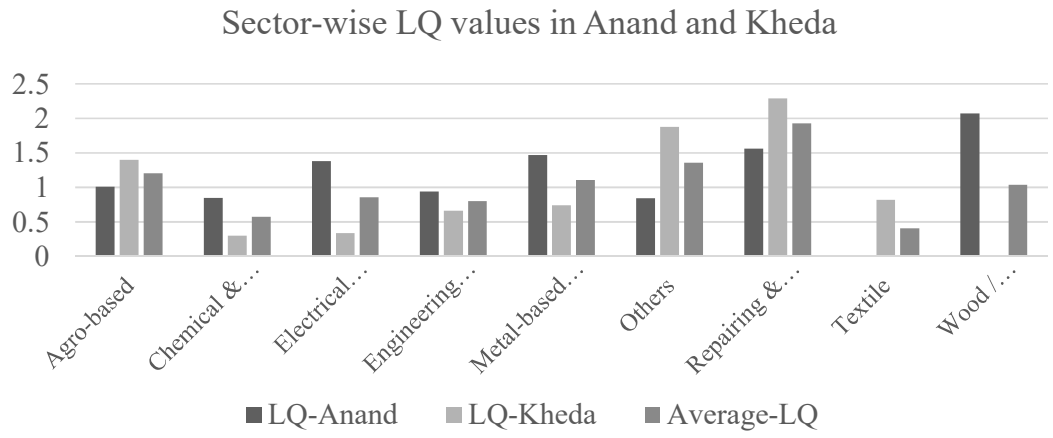


Figure 44 Sector-wise LQ values in Anand and Kheda

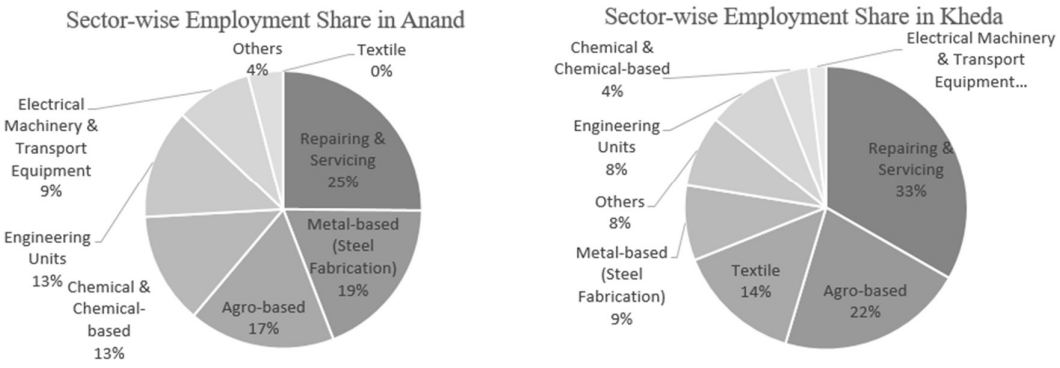


Figure 45 Sector-wise Employment Share in Anand and Kheda

Table 21 Economic Base Analysis using Location Quotient (LQ)

Sector	Employment			LQ		LQ Category	
	Anand	Kheda	Gujarat	Anand	Kheda	Anand	Kheda
Agro-based	2591	1620	105000	1.01	1.4	Balanced / Stable	Export-Oriented / Strong
Chemical & Chemical-based	1968	310	95000	0.85	0.3	Underrepresented / Opportunity	Underrepresented / Opportunity
Electrical Machinery & Transport Equipment	1351	150	40000	1.38	0.34	Export-Oriented / Strong	Underrepresented / Opportunity
Engineering Units	1960	620	85000	0.94	0.66	Balanced / Stable	Underrepresented / Opportunity
Metal-based (Steel Fabrication)	2880	650	80000	1.47	0.74	Export-Oriented / Strong	Underrepresented / Opportunity
Others	619	622	30000	0.84	1.88	Underrepresented / Opportunity	Export-Oriented / Strong
Repairing & Servicing	3820	2521	100000	1.56	2.29	Export-Oriented / Strong	Export-Oriented / Strong
Textile	0	1086	120000	0.0	0.82	Underrepresented / Opportunity	Underrepresented / Opportunity
Wood/Wooden Furniture	1618	0	32000	2.07	0.0	Export-Oriented / Strong	Underrepresented / Opportunity

Analysis & Justification (Summary)

The **agro-based sector** demonstrates a **strong Location Quotient (LQ)** in both Anand and Kheda, justifying the promotion of **agri-processing and agro-logistics clusters**. The **engineering sector** is **highly concentrated in Anand**, indicating potential for an **MSME cluster**, whereas **Kheda requires catalytic interventions** for growth. The **chemical sector**, though **balanced in Anand** and **underrepresented in Kheda**, is **not suitable** for integration into **HSR-oriented TOD**. **Electrical machinery** shows **sectoral specialization in Anand**, supporting **industrial diversification**. **Textiles and other sectors** are **underrepresented** in both districts and are **not recommended** unless supported by a **specific policy push**.

Gap Analysis

Table 22 Gap Analysis

Taluka	Gap Area	Identified Gap	Statistical Justification	Ideal Benchmark / Guideline	Key Data Source
Anand	Agro & Dairy Processing	Heavy reliance on primary agriculture; low food processing & logistics capacity	75% cultivable land, 89% irrigation; 70.43% agri workers -Source: Skill Gap Report	10-15% of agri output to be processed (MoFPI, PMFME)	District-wise Skill Gap Study for Gujarat
	Industrial Spread	Industrial activity concentrated in Anand & Tarapur; peripheral talukas lack MSME nodes	82 large units in Anand district; Tarapur & Anand dominate â€“ Source: ASI + Skill Gap Report	At least 1 functional MSME cluster per taluka (UDYOG AADHAAR, NSIC)	ASI Report 2021-22 + Skill Gap Report
	Service Sector Development	Very low service MSME jobs; limited IT, tourism, and innovation-based enterprises	Only 6.6% MSME jobs in services (district-wide) â€“ Source: Skill Gap Report	20-25% MSME employment in services (MoSPI/MSME Policy)	District-wise Skill Gap Study for Gujarat
	Skilling Infrastructure	Insufficient vocational seat capacity; underrepresentation of private training centers	2.02 vocational seats per 1000 pop; low private participation -Source: Skill Gap Report	4-5 seats/1000 population; skilling infra near industry (NSDC)	District-wise Skill Gap Study for Gujarat
Nadiad	Agro Value Chain	No structured cold chain infrastructure or food park serving regional agriculture	No cold chain, aggregation yard, or food park in taluka - Source: APEDA, NSDC Summary	Cold chain facility every 100 km or per regional node (APEDA, MoFPI)	APEDA + MoFPI Guidelines + NSDC Taluka Infra Summary
	MSME Cluster Infrastructure	No plug-and-play MSME parks near SH/NH; lack of industrial estate in Matar/Nadiad	25-28 large units in Matar/Nadiad; no zoned clusters -Source: ASI Report	Plug-and-play MSME parks within 10-15 km of urban centers (Make in India)	ASI 2021-22 Report + MSME Infrastructure Report
	Workforce Integration	Low skill-to-job alignment; ITIs disconnected from sectoral demand	3,414 ITI seats in Nadiad but no colocated industrial zone- Source: Skill Gap Report	Skill-industry alignment zones recommended in PMKVY 3.0	Skill Gap Study (Nadiad Taluka) + PMKVY Guidelines
	Urban Growth & Social Infrastructure	Lack of structured urban growth plans; female literacy gap; healthcare infra below URDPFI norms	Female literacy gap = 15.47%; 1 health facility per 33,000 pop -Source: Skill Gap Report	1 PHC per 20,000; density 400-600/kmÂ²; inclusive zoning (URDPFI)	Skill Gap Study + URDPFI + Census 2011

The gap analysis identifies **critical regional deficiencies** that the proposed LAP must resolve. A **vocational-skilling shortfall** of just **2.02 seats per 1 000 population**—far below the **4–5 seat** norm—underscores the need for a **dedicated institutional and training campus**. **MSME activity** is clustered in Anand, while **Kheda lacks formal industrial nodes**, warranting a **decentralized light-industry hub**. The **absence of wholesale trade and logistics infrastructure** supports creating a **trade-oriented logistics park** leveraging proximity to the **HSR corridor and national highways**. Finally, primary health coverage is inadequate at **1 PHC per 33 000 residents** versus the **1 : 20,000** benchmark, necessitating new **civic and healthcare facilities** within the LAP.

6.9 Activity Determination – Anand/Nadiad HSR Station

The LAP allocates land across **seven functional zones**—**Institutional & Skilling (20%)**, **Financial Services (15%)**, **Urban Logistics (10%)**, **High-Density Housing (20%)**, **Healthcare (10%)**, **Public Greens (15%)**, and **Civic Utilities (5%)**—based on expert ratings (4.0–4.6) and identified development gaps.

Land share percentages were directly recommended by domain experts, aligning with **High-Speed Rail–oriented development goals** and **TOD-compatible planning principles** for compact, mixed-use, and accessible urban form.

Table 23 Proposed LAP Zone Core Activities -Anand/Nadiad

Proposed LAP Zone	Core Activities	Justification Summary (Survey, 3V, LQ, Gap)	Suggested Land Share
Institutional & Skilling Hub	• Higher education campuses • Research & development centers • Technical training institutes	Expert Rating: 4.6. Strong Place Score due to Anand's academic base. LQ indicates dominance in education sector. Identified regional skill gap supports this priority.	20%
Financial & Business Services Zone	• IT/Co-working spaces • B2B service offices • Enterprise incubation hubs	Expert Rating: 4.1. High Market potential; supports job generation. Moderate LQ but strong spatial accessibility. Reinforces employment clustering.	15%
Urban Logistics & Aggregation	• Cold chain transit • Parcel aggregation yards • Non-polluting storage hubs	Expert Rating: 4.5. Strong Node Score near NH/SH. Logistics gap noted in planning reports. Demand supported by regional peri-urban produce trade.	10%
High-Density Residential Cluster (TOD)	• Rental housing for service workforce • Mixed-use residential precincts • Walk-to-work housing units	Expert Rating: 4.2. Needed for workforce and professional housing near station. Affordable housing suggested outside LAP area. Supports TOD compact living principles.	20%
Healthcare & Wellness Zone	• Multispecialty clinics • Diagnostic and wellness centers • Urban emergency care	Expert Rating: 4.0. Healthcare service gap identified. Moderate Place and Market score. Complements Institutional and Residential zones.	10%
Public Green & Ecological Reserve	• Natural drain buffers • TOD greens and shaded corridors • Urban parks and climate-responsive open spaces	Expert Rating: 4.5. Strong suitability in slope/drain areas. Enhances walkability and heat mitigation. Essential under TOD planning guidelines.	15%
Civic & Utility Support Facilities	• Utilities, control offices • Ward-level admin functions • Police, fire and emergency infra	Expert Rating: 3.2. Already present in Anand/Nadiad cores. Only minor share needed inside LAP for support role.	5%

Key Takeaways

The **Institutional and Skilling Zones** anchor the LAP, driven by **Anand's educational base** and **skill gap needs**. **High-Density Residential Clusters** support **walk-to-work TOD housing**, while **Logistics and Healthcare Zones** enable **regional service and economic integration**.

6.10 Land Suitability Analysis – Anand / Nadiad HSR LAP Area

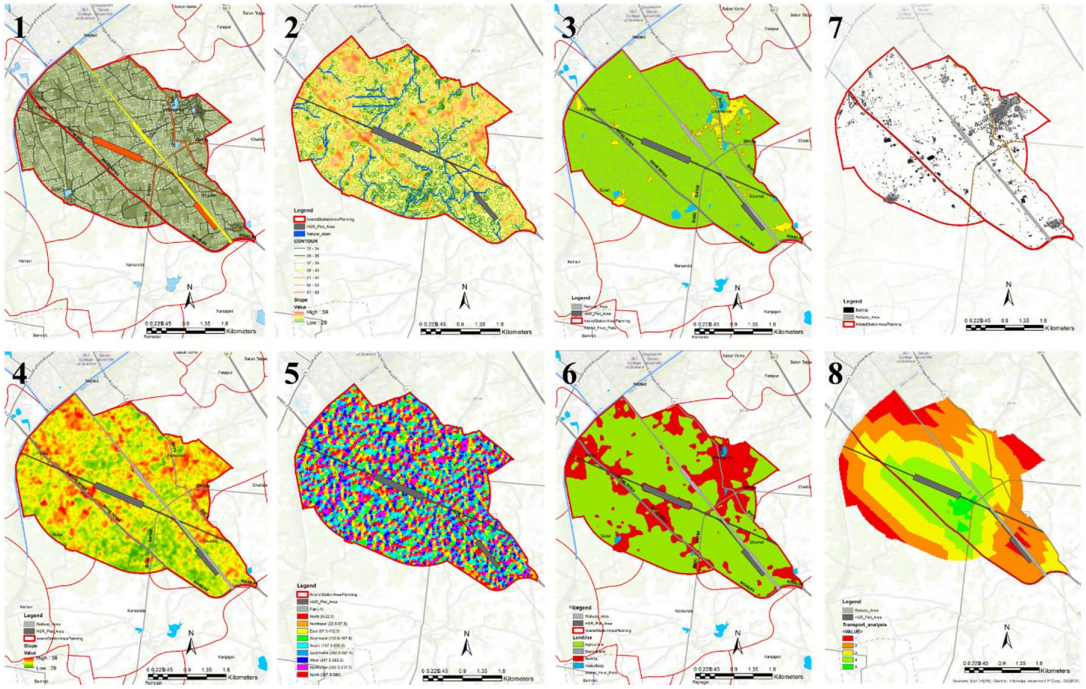


Figure 46 1-Plot pattern, 2-Natural Drainage, 3-Land use, 4-Slope, 5-Aspect, 6-Land Cover, 7- Built-up, 8-Accessibilty

Key Parameters Used:

The land suitability analysis used multiple **maps** for clear assessment. **Map 1** shows **plot boundaries** and **LAP extent**. **Map 2** outlines **natural drainage** and **contour lines**. **Map 3** displays **existing land use**. **Map 4** analyzes **slope gradients**. **Map 5** shows **terrain aspect**. **Map 6** depicts **land cover**. **Map 7** differentiates **built-up** and **open land**. **Map 8** combines **transport proximity** to **HSR, NH, SH, and rail networks**.

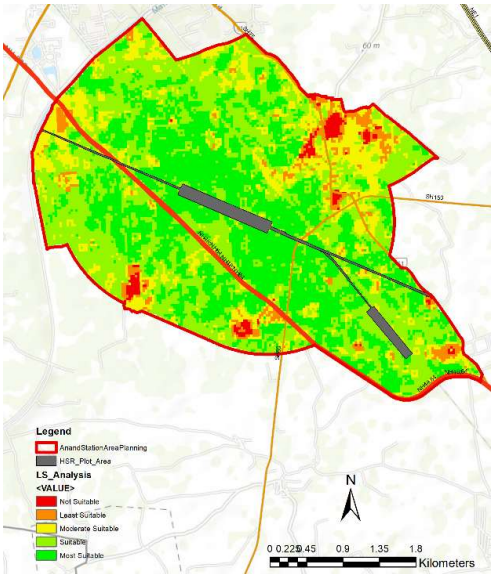


Figure 47 Land Suitability Map- Anand/Nadiad HSR LAP

Final Land Suitability Analysis – Anand/Nadiad Station Area

The analysis integrated **12 spatial layers**. **Highly suitable land** is concentrated in the **eastern and northeastern zones**, characterized by **minimal slope** and **optimal proximity** to highways and the HSR station. **Restricted and unsuitable zones** occur where **environmental or physical constraints** exist.

Key Takeaways

The **comparative analysis** of **Surat** and **Anand/Nadiad** HSR station areas highlights both **shared opportunities** and **distinct planning needs**. As **greenfield locations**, both sites possess potential for **Transit-Oriented Development (TOD)**, but they differ significantly in **urban context** and **development readiness**. **Surat**, located near emerging clusters like **DREAM City** and **Khajod**, exhibits **strong regional connectivity**, **high market traction**, and **visible development momentum**. Its growth is largely **market-driven**, necessitating policies that **integrate ongoing investments** with **TOD principles** to ensure **cohesive urban expansion**.

In contrast, the **Anand/Nadiad** HSR area is defined by a **more rural setting** with **limited urban influence**. While centrally positioned between two growing cities and offering **substantial land availability**, its development trajectory remains **uncertain** without **strategic interventions**. Growth here must be **vision-led**, supported by **phased infrastructure**, **institutional facilitation**, and **long-term planning incentives**.

In summary, while both areas require **structured planning** under TOD frameworks, **Surat** demands **immediate alignment with dynamic market forces**, whereas **Anand/Nadiad** calls for a **proactive, infrastructure-led approach** to unlock its **latent potential**.

Summary: The chapter delivers a thorough evaluation of Surat and Anand/Nadiad HSR stations, applying the 3V Framework and economic analysis to uncover development potential and constraints. Combined with land suitability data and stakeholder feedback, it establishes a solid basis for tailored zoning and strategic planning interventions in the respective LAPs.

Chapter -7

PLANNING PROPOSAL, INTERVENTIONS AND RECOMMENDATIONS

This section outlines the proposed development framework and specific planning interventions for the Surat and Anand/Nadiad HSR station areas. It integrates analysis insights to recommend land use zoning, infrastructure improvements, connectivity enhancements, and policy measures aimed at fostering sustainable growth and maximizing the benefits of HSROD.

7.1 Surat HSR station LAP Schematic Zoning

Vision: High-Speed Rail Oriented Economic Hub

The overarching vision is to develop Surat as a **High-Speed Rail Oriented Economic Hub**, capitalizing on the transformative potential of high-speed rail connectivity. This initiative aims to strategically position Surat as a regional growth engine by integrating transport infrastructure with economic development, enabling efficient mobility, improved accessibility, and sustained urban expansion.

Mission: Sector-Integrated Local Area Plan

To achieve this vision, the mission is to prepare a **sector-integrated Local Area Plan (LAP)** anchored in the principles of **High-Speed Rail Oriented Development (HSROD)**. This plan will serve as a framework to guide land use, infrastructure investment, and urban design within the influence area of the HSR station, ensuring coordinated and inclusive growth.

Proposed Zonal Overview

The proposed zoning integrates **transit-oriented development**, **education**, **finance**, **B2B trade**, **housing**, **healthcare**, and **green infrastructure** around the HSR station. Zones are planned based on **proximity to transit**, **land availability**, and **economic synergy** with Surat's existing clusters. This strategic layout promotes **compact, connected, and sector-driven urban growth**.

Table 24 Proposed Zone recommended location based on Transport proximity

Proposed Zone	Recommended Location	Transport Proximity
TOD Core Zone	Central strip aligned with HSR station core; integrates financial activities	Within 0–400 m of HSR station
Higher Education and Skill Development Zone	Northern-most belt; well connected to SH; large land parcels available	400–1200 m from HSR station
Financial & Business Services Zone	West-central and southwest; adjacent to TOD and residential zones	400–800 m from HSR station
B2B & Wholesale Hub	Southern half; large blocks, connected to metro and roads	800–1500 m from HSR; good metro access
High-Density Residential Cluster	Yellow zones between institutional and TOD areas; walkable proximity	400–1000 m buffer from TOD
Healthcare & Wellness Zone	Eastern pink zones; placed at edge to capture broader population	Moderate proximity; near metro corridor
Public Green & Ecological Reserve	Buffer zones along river/drains and green corridor patches	Located in natural buffers and margins

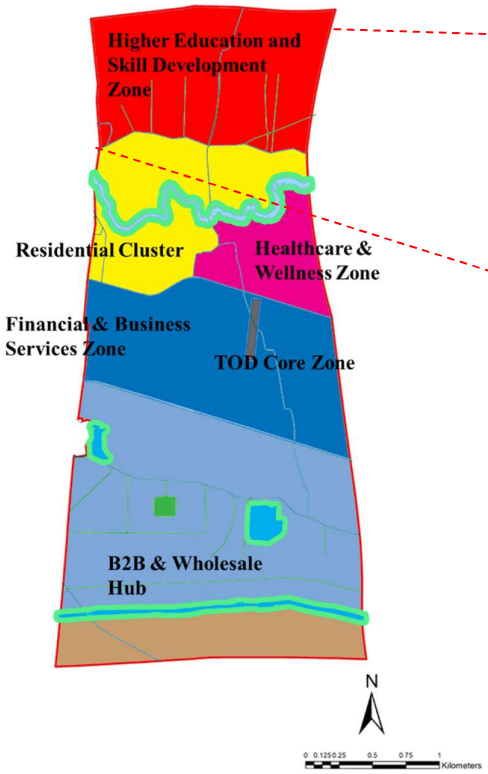


Figure 49 Schematic Zoning of Surat HSR LAP Area

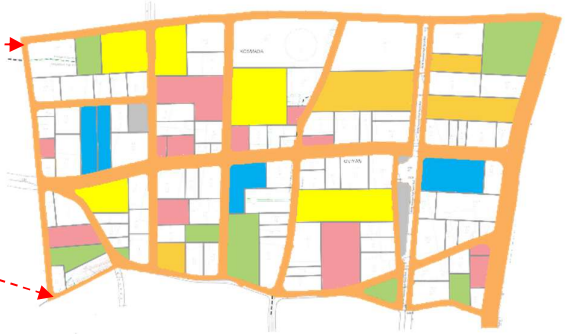


Figure 48 Schematic Zoning of Surat HSR TP Scheme Area

Table 25 TP Scheme alloted area for different land use and total area

TYPE	TOTAL AREA (Ha.)
Total Scheme Area	**163.33 Ha**

PURPOSE	Area -Percentage
GARDEN	4.5-5 %
S.E.W.S.H.	5-5.5 %
SALE FOR COMMERCIAL	7.5-8%
SALE FOR RESIDENTIAL	8-8.5%
SOCIAL INFRASTRUCTURE	5-5.5%
PARKING	1-1.25%
TOTAL	**31-34 %**

7.2 Anand / Nadiad HSR station LAP Schematic Zoning

Vision: High-Speed Rail Oriented Development Hub

The overarching vision is to develop Anand/Nadiad as a **High-Speed Rail Oriented Development (HSROD) Hub**, leveraging the area's Greenfield character and strategic connectivity. This initiative seeks to create a balanced urban node that supports regional growth by integrating land use planning with transit infrastructure, enabling compact development, accessible services, and sustainable urban expansion.

Mission: Sector-Based Local Area Plan

To achieve this vision, the mission is to prepare a **sector-based Local Area Plan (LAP)** grounded in HSROD principles. This plan will provide a strategic framework to organize land use, infrastructure provisioning, and spatial planning, with a focus on aligning **institutional zones, logistics, residential clusters, healthcare, and green infrastructure** to promote integrated and future-ready development around the HSR station.

Proposed Zonal Overview

Proposed Zone	Recommended Location	Transport Proximity
TOD Core Zone	Central zone around HSR, Covers both sides of the railway track, Lies within highest accessibility area	Within **0–400 m** of HSR station
Institutional & Skilling Hub	East of HSR station, Select patches in northern sector, Avoids unsuitable slopes or built-up lands	**400–1200 m** from HSR station and near SH150
Financial & Business Services Zone	West side close to NH48,Near existing business growth node of Anand	**400–800 m** from HSR; along NH48
Urban Logistics & Aggregation	South-west edge, Near SH junction and NH64,Located away from residential zones	**Along NH64 and SH buffer**
High-Density Residential (TOD)	North-east and eastern edge, Located near SH150, Connected to Institutional and TOD zones	**800–1500 m** from HSR station
Healthcare & Wellness Zone	Southern sector, Near residential and institutional edges, Accessible via internal roads	**Moderate proximity** from HSR and housing clusters
Public Green & Ecological Reserve	Northern and south-eastern corners, Drainage-sensitive zones, Periphery of LAP boundary	**Low suitability areas** beyond **1500 m**
Civic & Utility Support Facilities	Near SH and NH intersections, Peripheral institutional interface, Avoiding TOD core	**800–1500 m** buffer; away from core TOD

The proposed zoning for Anand/Nadiad focuses on integrating **transit-supported development** with **education and skilling**, **logistics**, **walk-to-work housing**, **healthcare**, and **green public infrastructure** around the HSR station. The zoning map strategically aligns each zone based on **accessibility and land suitability**.

The **TOD Core** anchors the area around the HSR station, ensuring high-density activity. **Institutional and Financial zones** are positioned along **key access corridors** to maximize connectivity. **Mixed-Residential and Healthcare zones** are placed within **walkable proximity** to employment and essential services. The **Logistics zone** is situated near **highway edges**, ensuring minimal disruption to residential areas. **Civic and Public Green zones** enhance overall livability, while existing **Gamtal areas** are preserved to retain the **local cultural fabric**.

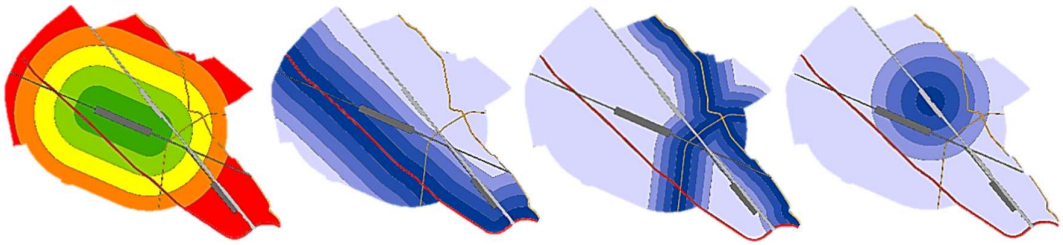


Figure 50 Transportation Proximity – HSR Station, National Highway , State Highway , Railway station

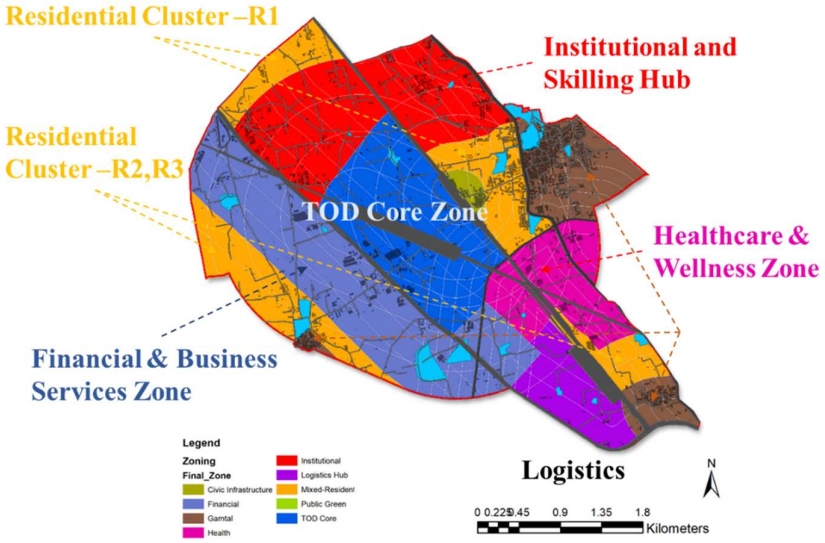
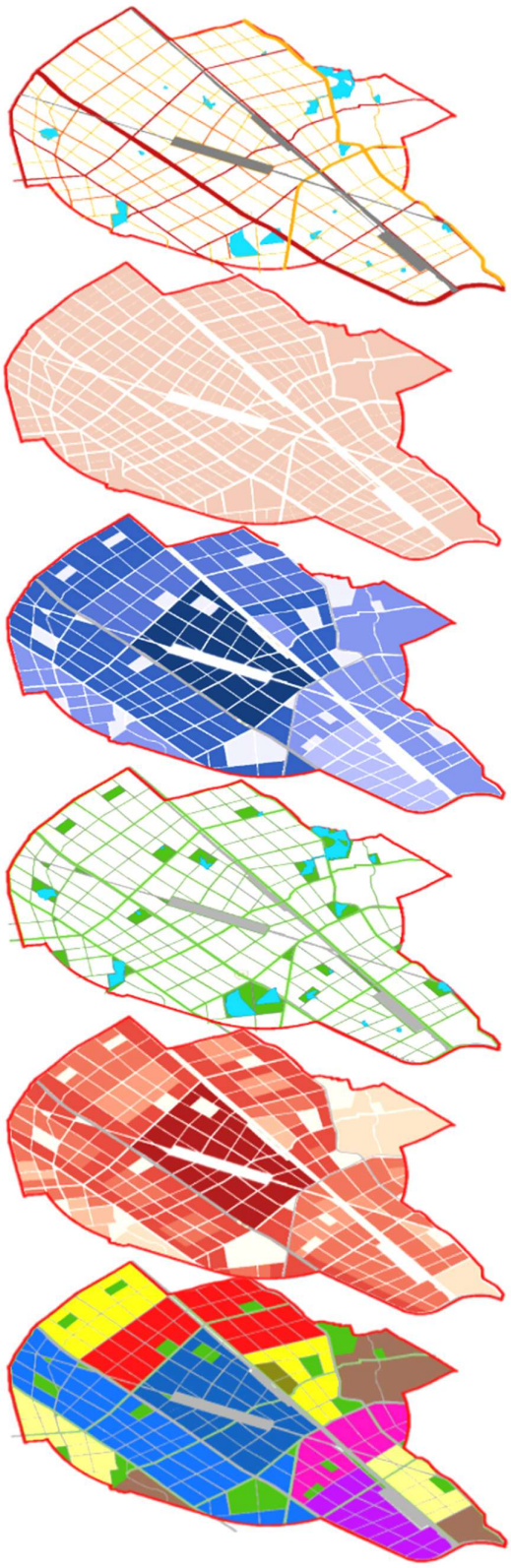


Figure 51 Proposed Schematic Zonning based on overlay method - Transportation proximity and Land suitability



1. Hierarchy of Roads

Proposes a structured **road network** to ensure efficient **circulation** and **multi-modal connectivity**.

2. Urban Block Structure

Defines **compact, walkable blocks** to support **mixed-use** and **transit-oriented development**.

3. FSI Distribution

Allocates **higher FSI** near the **HSR station** to promote **dense, accessible urban growth**.

4. Public Space Network (Green and Blue Infrastructure)

Integrates **green and blue infrastructure** to enhance **ecological resilience** and **urban livability**.

5. Permissible Height

Permits **taller buildings** near the station core, tapering heights for **contextual harmony**.

6. Character-Based Zoning

Applies zoning based on **urban character** to foster **vibrant** and **adaptable precincts**.

Figure 52 Schematic Layout of Proposed LAP

The proposed Local Area Plan establishes a **structured road hierarchy**, **compact block layout**, and **FSI gradient** to support **high-density, transit-oriented development**. It integrates **green-blue infrastructure** for **ecological resilience**, defines **context-sensitive building heights**, and applies **character-based zoning** to create **vibrant, inclusive urban precincts** aligned with the vision of **HSROD**.

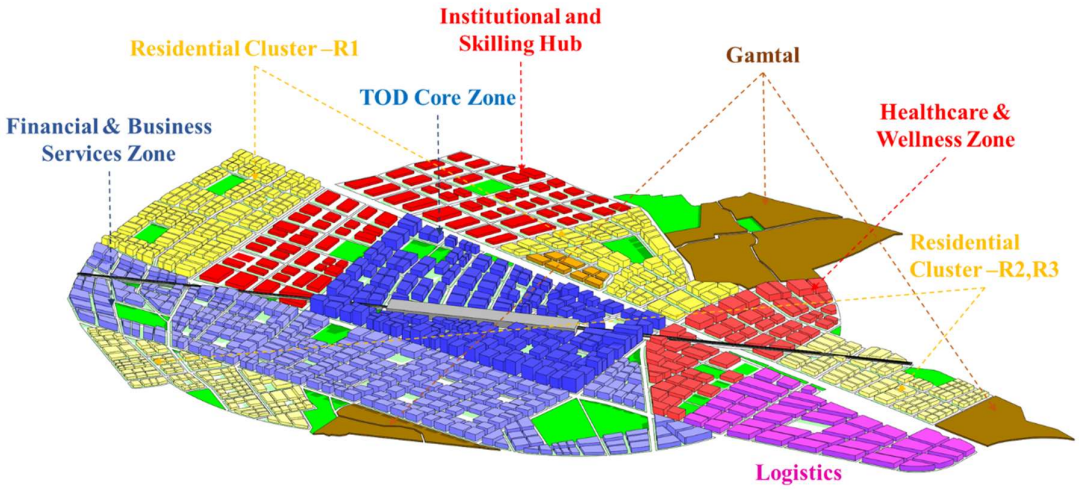


Figure 53 Example of Envisioned Built form for the LAP area

7.3 Recommendations

Integrated Land-Use & Transit Planning — Authoritative Framework

To capture the full accessibility dividend of the HSR stations, the LAP adopts a **station-area Transit-Oriented Development (TOD) overlay** grounded in the Gujarat Comprehensive General Development Control Regulations, 2017 (GDCR) and the MoHUA National TOD Policy (2017).

Key principles are:

- **Compact, mixed-use urban form** within the first kilometer of each station.
- **Three-tier FSI gradient** tied to both **distance from the concourse** and **abutting Right-of-Way (ROW)**.
- **Mandatory ground-floor activation** and a **ban on single-use gated layouts**.
- **Transferable Development Rights (TDR)** to move surplus FSI from low-sensitivity fringes into the core, protecting heritage pockets and peri-urban villages while maintaining market viability.

TOD Zone (radial distance)	Abutting ROW (m)	Base FSI(as - of-right)	Maximum FSI (premium / TDR)	Min. Mixed -Use GFA	Permissible Height(GDCR Rule 26)	Front Setback	Ground-Floor Activation(build-to-line)
Zone 1: Station Core 0 – 500 m	≥ 24 (arterial) 18–24 (sub-arterial)	2.5	**5.0**	**≥ 40 %**	Up to 70 m (1 m height per 3 m ROW)	9 m (arterial) 6 m (collector)	**≥ 70 % facade length** at 0–1 m from property line
Zone 2: Transition 500 – 1,000 m	18–24 (sub-arterial)≥ 18 (collector)	2.0	**3.5**	≥ 25 %	Up to 45 m	6 m (sub-arterial)4.5 m (collector)	≥ 50 % facade length
Zone 3: Peripheral TOD Support 1,000 – 2,000 m	12–18 (collector / local)	1.5	**2.0**	Context-based	GDCR default	4.5 m (collector) 3 m (local)	≥ 30 % facade length

Mobility, Access & Connectivity

The LAP establishes a **hierarchical street network** following URDPFI standards to optimize **multi-modal access and last-mile connectivity** around the HSR stations. Key arterials (ROW 30–45 m) are equipped with **dedicated dual cycle lanes and wide footpaths** to promote non-motorized transport. Local streets (ROW 12 m) are designed for **low-speed traffic (25 km/h)** with frequent **raised pedestrian crossings** enhancing safety and walkability.

Figure 54 Proposed hierarchy of Road Section

To manage station-area parking demand and reduce traffic congestion, **on-street parking within 500 m of HSR stations is capped at 1 ECS per 100 m²**, while **incentives for multi-level shared parking (0.1 FSI bonus)** encourage efficient land use and transit-oriented development principles.

A continuous **6 km greenway spine**, integrated with existing natural drainage corridors, is recommended to provide **safe, car-free, landscaped pedestrian and cycling routes** connecting residential and employment hubs to station plazas, fostering sustainable mobility and healthy urban living

Sustainable Infrastructure & Utilities

The plan adopts a **decentralized, scalable infrastructure model** aligned with URDPFI's "Smart Infrastructure Zone" concept. Each 20–25 ha **Urban Infrastructure Zone (UIZ)** integrates a 1 MLD modular **Sewerage Treatment Plant**, dual-plumbing for recycled water, and a micro-grid delivering **10 % on-site solar** by Phase -II. Solid waste is managed through a two-bin door-to-door system and a 5 TPD Material-Recovery Facility per 50,000 residents. Stormwater is detained in landscaped retention ponds sized at **1–3 % of catchment area**. The municipal authority must publish a five-year rolling capital-investment plan and offer **Infrastructure Service Level Agreements (SLAs)** to private developers who co-finance utilities.

Economic Development & Employment

The Local Area Plan (LAP) leverages the High-Speed Rail's enhanced connectivity to establish the station precincts as a **regional hub for knowledge, services, and logistics**. A **50-hectare Innovation District** (FSI 3.5) targets **IT-BPM, R&D, and fintech firms**, while a **25-hectare Clean Logistics Park** (FSI 2.0) utilizes HSR freight capacity to support sustainable logistics.

A **Clean-Use Priority List** fast-tracks approvals for **zero-discharge industries** and imposes a **50% higher conversion fee** on environmentally sensitive red-category uses to protect land use integrity. The **HSR Business Desk** provides a **single-window clearance system** to streamline approvals and facilitate investment.

Developers integrating **co-working spaces** or **skill-training centres** receive an additional

0.2 FSI incentive. This framework promotes **high-value employment**, attracts innovative industries, and strengthens the HSR station precinct as a key **economic growth node**.

Housing & Social Infrastructure

The Local Area Plan (LAP) prioritizes **diversified, high-density, mixed-income housing** to promote effective job–housing integration within the TOD overlay. Residential developments on plots exceeding 2,000 m² are required to comply with **Inclusionary Zoning (IZ)**, mandating a minimum of **15% EWS/LIG units**. Compliance is incentivized through a **0.4 FSI bonus** and a **15% rebate on infrastructure fees**.

High-rise residential towers (up to 70 m) are strategically concentrated within a 700-meter radius of major employment hubs, while **mid-rise affordable housing** (up to 7 floors or 25 m) is encouraged along key collector roads to balance density and accessibility. Social infrastructure standards adhere to URDPFI guidelines, providing **one neighborhood park (0.4 ha) per 5,000 residents** and **one primary school per 7,500 residents**, ensuring adequate community amenities

Governance, Phasing & Implementation

The **HSR station**, situated within **Nadiad Municipal Corporation**, functions as a regional hub serving both **Anand Municipal Corporation** and Nadiad. Since parts of the LAP extend beyond municipal boundaries, a **Twin-City Regional Coordination Committee**—comprising representatives from Anand Municipal Corporation, Nadiad Municipal Corporation, Urban Development Authority, Rail Corporation, and State Finance—is established to ensure integrated governance and seamless implementation.

The phased implementation is structured as follows:

- **Phase 1: TOD Core (0–400 m)** – Focus on transit-oriented development with high-density mixed-use and residential infrastructure closest to the station.
- **Phase 2: Financial & Social Infrastructure Expansion (400–1200 m)** – Development of the Innovation District, financial services, education, and healthcare facilities.
- **Phase 3: Logistics & Peripheral Development (beyond 1200 m)** – Establishment of clean logistics parks and associated freight infrastructure leveraging the HSR network.

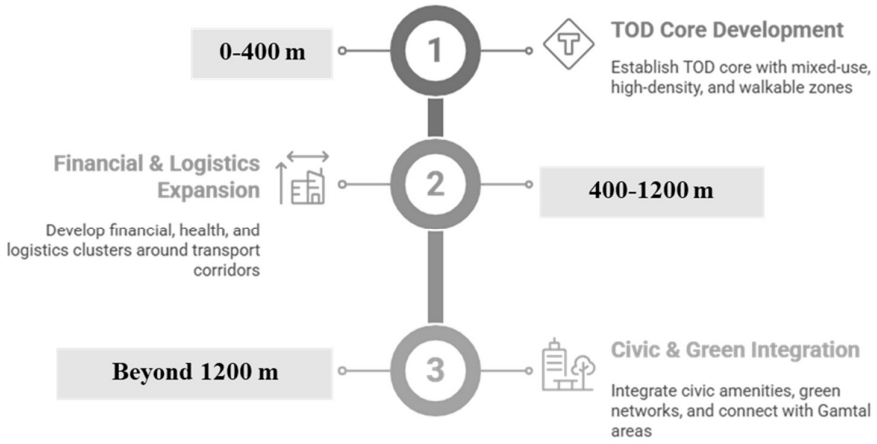

0-400 m
1
TOD Core Development
Establish TOD core with mixed-use, high-density, and walkable zones
Financial & Logistics Expansion
Develop financial, health, and logistics clusters around transport corridors
2
400-1200 m
Beyond 1200 m
3
Civic & Green Integration
Integrate civic amenities, green networks, and connect with Gamtal areas

Figure 55 Phased Implementation of Anand/Nadiad HSR LAP

Funding sources include **land-value capture** (betterment levy ₹1,500–2,000/m²), **green bonds**, and **public-private partnerships (PPPs)**. Annual reviews monitor key performance indicators such as **TOD FSI uptake**, **affordable housing delivery**, and **modal share improvements**, with the coordination committee empowered to implement course corrections to meet project objectives.

Summary: Based on the comprehensive assessment, targeted planning interventions and policy recommendations are presented to guide the Local Area Plans. Emphasis is placed on optimizing land use, improving accessibility, and supporting economic activities to create vibrant, well-connected growth hubs around the HSR stations.

7.4 Conclusion

This study presents a comprehensive planning framework for High-Speed Rail Oriented Development (HSROD) around the Surat and Anand/Nadiad HSR station areas, applying the Transit-Oriented Development (TOD) 3V Framework—Node, Place, and Market. By combining land suitability analysis and economic base profiling, the research identifies distinct development potentials for each location. Surat, embedded within an established urban core, shows readiness for rapid growth with strong market activation, while Anand/Nadiad, as a Greenfield site, offers opportunities for planned, phased urban expansion over the long term.

The proposed Station Area Development Plans (SADPs) respond to the unique contexts of both stations, promoting efficient land use, enhanced multimodal connectivity, and strategic economic clustering. Through spatial analysis, zoning, and expert consultation, the plans offer practical interventions aimed at creating vibrant, well-connected, and economically sustainable station influence zones.

Overall, this framework serves as a roadmap for leveraging High-Speed Rail infrastructure to foster economically active, integrated urban hubs aligned with regional development goals. It provides planners and policymakers with actionable guidance to maximize the transformative potential of HSR stations, supporting infrastructure-led and sustainable urban growth.

7.5 Future Scope of Research

Economic Feasibility and Market Validation

It is important to evaluate the market demand and real estate viability of proposed land uses through sector-wise analyses and business interest assessments to confirm practical feasibility.

Institutional Mechanisms and Stakeholder Engagement

Research should explore governance structures and implementation agencies while emphasizing active stakeholder participation, especially at the plot level, supported by effective policy tools.

Extension to Brownfield Station Areas

The methodology for Greenfield stations should be tested in brownfield contexts, focusing on urban retrofitting, redevelopment, and infrastructure densification for integrated regeneration.

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